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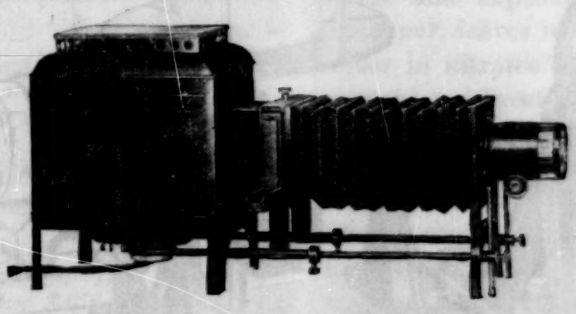

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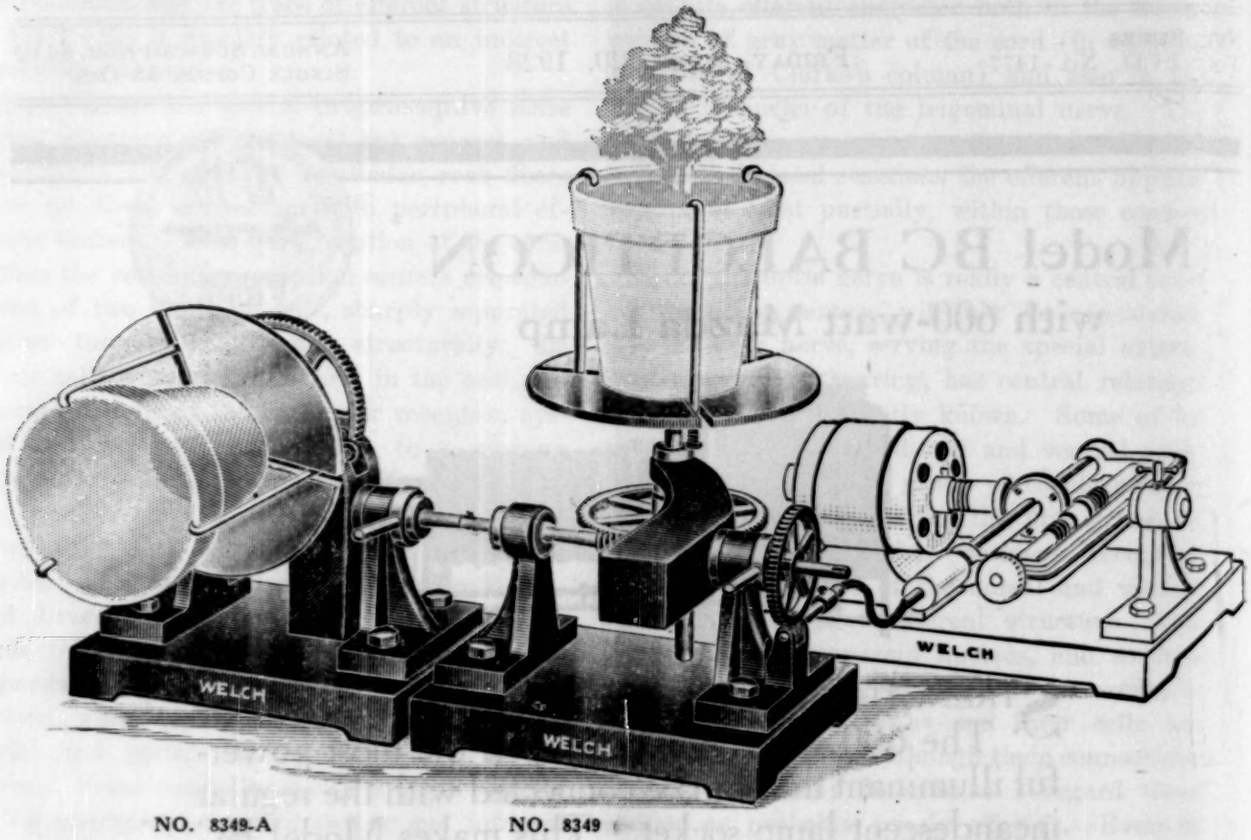

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ON THE FORMATION OF ORGANIC COMPOUNDS FROM INORGANIC BY THE INFLUENCE OF LIGHT

THE incentive for my first photochemical research, which was begun in 1911, was received through reading Schimper's work on the relation between nitrate reduction in green leaves and exposure to light. According to Schimper, leaves in the shade are always much richer in nitrates than leaves which have been exposed to direct sunlight. Little or nothing was known at that time in regard to the chemical aspect of nitrate reduction under the influence of light. It was not until later that I became acquainted with the important work of E. Laurent in which the formation of oxygen gas and potassium nitrite by the action of sunlight on sterilized potassium nitrate was described.

My photochemical experiments, carried out in Zürich, between 1911 and 1914, were concerned with the reduction of nitrates by light energy, either alone or in the presence of organic substances. At that time I did not employ iron in my experiments. My attention was first called to the importance of iron in nitrate reduction by some bacteriological experiments which I carried out during the war. In my work with cholera bacilli I found that their iron absorption and assimilation must be in direct relation with their power of reducing nitrates to nitrites and ammonia. On searching the literature for similar observations, I found that Schimper describes an experiment in which iron free (chlorotic) leaves were unable to reduce any nitrate at all, even on exposure to intense light.

It is very striking to observe the great rapidity with which cholera bacilli, taken from the intestine of a cholera victim immediately after death, reduce nitrates to nitrites in a peptone culture. In the case of cholera bacteria the reduction proceeds just as rapidly in the dark as it does in the light. The reduction of ni-

trates, however, as I have shown, stands here in direct relation to the oxygen respiration of the bacteria and also to their iron content. These observations led me to use iron in my purely chemical investigations on nitrate reduction.

As regards the chemistry of the process, the only relation known at that time was that ferrous hydroxide reduced potassium nitrate and in the process became oxidized to the ferric compound at the expense of the nitrate oxygen. From the physiological standpoint this stoichiometric process could have no importance, since only traces of iron are present in cells and these traces must become inactive at once because of their oxidation to the ferric compound.

I therefore had to search for a process in vitro which would show that the smallest traces of iron were capable of reducing large quantities of nitrate or nitrite and that this reduction failed entirely in the absence of iron.

In other words, I tried to find a chemical reduction process in which the iron acted as a catalyst. I succeeded in doing this when investigations with nitrites and sugar in carbonate solution were carried out. Grape sugar solutions do not reduce nitrates or nitrites, even when they are heated under pressure, but the smallest trace of an iron salt is sufficient to reduce a large amount of nitrite on warming with glucose in weakly alkaline solution. Under these conditions nitrates remain entirely unattacked.

The rôle which traces of iron play in this reduction process was entirely incomprehensible. Further experiments have thrown light on this chemical process, but a detailed description would be out of place here. The main points, however, should be discussed, *i. e.*, why nitrates remain unattacked and why nitrites are reduced extremely easily to ammonia, with the successive formation of the intermediate products KNO_2 and KNO.

The character of the alkali nitrites is determined by the auxiliary valencies of the nitrogen central atom:

$$\begin{pmatrix} O \\ N\text{.....} \\ O \end{pmatrix} K$$

while that of the alkali nitrates is determined by one oxygen atom, which I call the nitrate oxygen atom.

$$\begin{pmatrix} O \\ NO\text{.....} \\ O \end{pmatrix} K$$

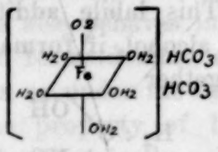
This atom possesses residual affinity, but the nitrogen atom is completely masked. Nitrogen has a great affinity for iron and the reduction of alkali nitrites is induced by a primary linkage of the nitrite nitrogen to the iron nucleus. On the other hand, the affinity of iron for nitrate oxygen is not sufficiently great to bring about a primary addition and subsequent splitting off of an oxygen atom.

The question as to the manner in which nitrates were reduced to nitrites in biological processes was still unsolved. From my experiments with cholera bacteria and from Schimper's observation, it could be seen that oxygen appeared to be directly involved in the reduction of nitrates. In following up this idea experimentally I observed the surprising fact that oxygen in the presence of ferrous salts reduces nitrates instantaneously, even in the cold, with the formation of nitrites. This observation was fundamentally new. It was known that ferrous hydroxide or ferrous bicarbonate reduces alkali nitrates, but it was believed up to this time that the iron was oxidized at the expense of the nitrate oxygen. I have found that ferrous bicarbonate or hydroxide in the absence of oxygen even at the temperature of boiling water does not attack alkali nitrates to the slightest extent; the presence of oxygen, however, brings about immediate reduction to nitrite and there is a direct relation between the amount of oxygen dissolved in the water and the amount of nitrite formed.

This chemical process I should like to designate as the origin of fertilization. Two inorganic compounds of great energy content, such as ferrous bicarbonate and potassium nitrate, remain unchanged in an oxygen free aqueous solution. In contact with air, moist ferrous bicarbonate rapidly absorbs oxygen, either from the air or from water, and links a molecule in the inner sphere of the iron nucleus. This oxygen absorption I should like to compare with the fertilization of an ovum, since from the almost non-magnetic ferrous hydroxide or ferrous bicarbonate there is formed a peroxide compound which closely approaches metallic iron in its magnetic prop-

erties. This extremely energetic peroxide compound draws a molecule of potassium nitrate into the inner sphere of the iron nucleus and splits an oxygen atom from it with the formation of nitrite. There follows further reduction of the nitrite to the extremely reactive compound potassium nitrosyl, K(NO), which, at the same time, reacts with organic compounds present, especially aldehydes, with the formation of carbon and nitrogen containing compounds. Ferrous bicarbonate and oxygen in this case assume the rôle of light and reduce alkali nitrates to nitrosyl, which is a very reactive amphoteric intermediate product either of nitrate reduction or of ammonia oxidation. Ferrous bicarbonate peroxide, however, can give up the temporarily loosely linked oxygen molecule, which is thus somewhat activated, to oxidizable compounds which are present in the same solution, just as hæmoglobin absorbs oxygen and gives it back again for oxidation or dehydrogenation purposes.

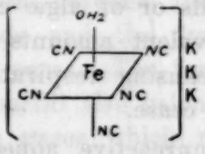
In this reaction, however, it is found that there is a selective action which depends upon the affinity of the compound to be oxidized to the central iron atom of the peroxide.



Compounds which are not primarily linked in the inner sphere by the iron atom are not oxidized. There is an analogy here to enzymatic reactions, which are characterized by their selective action brought about by residual affinity. In the reactions which we have described, residual affinity or auxiliary valence powers in the sense of Werner's theory play a decisive rôle. The selective character of this chemical reaction is probably based on them alone. Also, I believe that the reduction of nitrate to nitrite by light is introduced by the taking up of energy and the consequent activation of the auxiliary valence powers of the nitrate oxygen atom and of the oxygen of the water; the subsequent processes are reactions which can take place in the dark. In the case of the reduction of alkali nitrates with ferrous hydroxide peroxide, the energy is transmitted to the nitrate molecule by the strongly magnetic peroxide compound, with the splitting off of an oxygen molecule. The further reduction of alkali nitrite or nitrosyl to ammonia is doubtless brought about by nascent hydrogen formed by the decomposition of water molecules in the inner sphere through the action of the central iron atom in the peroxide compound.

From the preceding discussion it is apparent that many reactions are brought about by the fertilization of the iron molecule by molecular oxygen; there is, I believe, considerable evidence that the magnetic properties of the peroxide are in direct relation to its great chemical reactivity. It is worthy of note that complex ferric compounds are easily transformed into ferrous compounds by the influence of light or by hydrogen peroxide and thus are continually brought back into a reactive form which has the power of taking up oxygen. The well-known example is the reduction of potassium ferricyanide to ferrous compounds.

From neutral potassium ferrocyanide an alkaline compound is formed on exposure to sunlight for a period of a few seconds; on further illumination in the presence of air there results, besides free ferrous ions, an extremely reactive complex ferrous compound (potassium pentacyano-aquo-ferroate)



which links oxygen, nitric oxide or carbon monoxide to the central iron atom, just as hæmoglobin does. In air potassium pentacyano-aquo-ferroate absorbs and carries oxygen. Also in this case the oxidation of the oxidizable substances present takes place only when these substances are first linked coordinately in the inner sphere of the iron salt and, therefore, we are again dealing with a case of selective oxidation. Potassium pentacyano-peroxo-ferroate

$$\left(\mathrm{Fe}\begin{matrix}O_2\\(NC)_5\end{matrix}\right)K_3$$

behaves like an iron catalyst and its action as an oxygen carrier and activator and as an activator of inorganic and organic compounds which show affinity to iron I should like to

designate as the origin of respiration. The entrance of certain groups, in this case five cyanide groups, into the inner sphere of the iron nucleus, raises the power of the ferrous ion to absorb oxygen from the air. Especially interesting is the fact, observed by Miss Pfaltz and myself, that one reactive auxiliary valency of the iron nucleus can be made inactive by equivalent amounts of potassium cyanide, arsenic trioxide, carbon monoxide, or other blood poisons.

These purely chemical experiments harmonize with experiments of Jacques Loeb and of O. Warburg.

In 1906 Jacques Loeb expressed the view that the essential feature (or possibly one of the essential features) of the process of fertilization was the increase of the rate of oxidations in the egg and that this increase was caused by the membrane formation alone. These conclusions have been confirmed by the measurements of O. Warburg as well as those of Loeb and Wasteneys, both showing that the alteration or cytolysis of the cortical layer of the eggs is in some way connected with the increased rate of oxidations. O. Warburg has further shown that the oxidations in the sea urchin egg are due to a catalytic process in which iron acts as a catalyzer. The active iron ions of egg cells or of algæ can be made inactive by equivalent amounts of hydrocyanic acid, thereby causing respiration and nitrate assimilation to cease.

A neutral, unreactive aqueous solution of potassium ferrocyanide, which is quite stable in the dark, is extremely sensitive to light. The most important rays are those of long wave lengths, such as the bluish-yellow and red of daylight. These bring about the formation of an alkaline aquo base, as has been shown by L. W. Bass and myself. The reduction of alkali nitrates, on the other hand, is brought about only by light of short wave lengths, the ultra-violet and violet rays. In sunlight, during the summer, these rays are present in considerable quantities and the reduction of alkalinitrate to nitrite can be brought about in a short time if the oxygen which is split off is taken care of chemically, a process which may be brought about by addition of complex ferrous salts such as potassium ferrocyanide. The photochemical reaction $KNO_3 \rightarrow KNO_2 + O$ is thus accelerated by very small quantities of complex ferrous salts, a fact which was not known up to this time.

Let us now turn our attention to a compound which has not yet been isolated, but which is formed as a labile intermediate product in the reduction of nitrates with light energy or with ferrous hydroxide and oxygen. This compound is potassium nitrosyl K(NO), which was first described by A. Angeli in the so-called Angeli Salt

$$\begin{matrix} NOK \\ \vdots \\ NOOK \end{matrix}$$

Potassium nitrosyl reacts extremely readily with aldehydes with the formation of hydroxamic acids

$$R.C\begin{matrix} /\!/NOH \\ \backslash OH \end{matrix}$$

In this reaction it forms an intermediate product, as I found with Coert, which is an addition product of potassium nitrosyl to the aldehyde group, entirely analogous in composition to the product formed when hydrocyanic acid adds to an aldehyde with the formation of a cyanhydrin. This labile addition product is nitroso-methyl alcohol, if formaldehyde and nitrosyl react together

$$H_2 : C\begin{matrix} /OH \\ \backslash NO \end{matrix}$$

The stable product of the reaction, however, is formhydroxamic acid, which by itself is quite stable in the dark, but in light partially rearranges into aci-nitro methane.

$$H_2C = N\begin{matrix} /\!/O \\ \backslash OH \end{matrix}$$

By longer exposure to light various products result, among them methylamine. By color reactions it can be shown that the first product of the reduction of formhydroxamic acid by light energy is formaldoxime, which on further illumination suffers a partial Beckman rearrangement with the formation of formamide. Another part decomposes into hydrocyanic acid and water. Formaldoxime, which I found as one of the volatile constituents of cholera peptone culture, is doubtless a substance of physiological importance. With trivalent iron it

forms very characteristic deep-red complex salts, which in light are transformed rapidly into colorless salts with bivalent iron.

Anhydrous formaldoxime polymerizes readily to a trimolecular form. In the dark in aqueous solution it is comparatively stable. In weakly alkaline solution or on exposure to light, however, there results a rearrangement of the atoms with the formation of an extremely labile intermediate product which links chemically to other formaldehyde molecules; compounds are thus formed which contain several carbon and nitrogen atoms linked together. In sunlight from formaldoxime and formaldehyde are formed cyclic nitrogen compounds which contain pyridine and pyrrol rings and which give the typical alkaloid reactions. Acetaldoxime behaves in an entirely analogous manner. In the spring of 1914 I exposed to sunlight on the roof of the Schatzalpsanatorium in Davos, in sealed glass flasks, a large quantity of acetaldoxime solution containing aqueous formaldehyde; the mixture formed a clear mobile liquid. One year later the flask contained, in place of the mobile liquid, a thick dark brown syrup which I did not have the opportunity to investigate further.

Nitromethane also behaves in a manner entirely similar to formaldoxime, since in weakly alkaline solution or under the influence of light it possesses the property of linking formaldehyde molecules chemically. In the case of nitromethane an intermediate product is known, namely, isonitrobutylglycerine, which Henry obtained from nitromethane and formaldehyde on the addition of traces of an alkali salt. I observed that the same compound results when nitromethane and formaldehyde in aqueous solution are exposed to the light from a mercury lamp. The formation of iso-nitrobutylglycerine proves again that compounds of the type of aci-nitromethane, formhydroxamic acid or aliphatic aldoximes react with formaldehyde readily to form compounds with a larger number of carbon atoms, a fact which is of particular importance in the formation of organic compounds from inorganic. The connection between the formation of iso-nitrobutyl glycerine and dihydroxyacetone oxime with compounds such as alanine, serine, etc., will only be indicated. The formation of compounds of this type from inorganic substances and light has not yet been realized experimentally. The fact should be mentioned that a short exposure of formhydroxamic acid in the presence of traces of iron to mercury light, or a long exposure to mercury light of a mixture of potassium nitrite, carbon monoxide gas and traces of ferric chloride gives a water solution containing amino nitrogen which forms dyestuffs with triketo-hydrindin hydrate, just as α-amino acids do. The completion of this work was interrupted by the war, and because of other circumstances can not be taken up at the present time. Recently E. C. C. Baly has repeated and extended my investigations and has confirmed all the results with regard to the formation of formhydroxamic acid, methylamine, alkaloids and α-amino acids.

By illumination of alkali nitrates with daylight in the presence of formaldehyde gases are formed which in their qualitative composition agree with the gases formed by soil bacteria. They are chiefly nitrous oxide, hydrogen, nitrogen, oxygen, carbon dioxide, carbon monoxide, traces of nitric oxide and hydrocyanic acid. The formation of formhydroxamic acid and of formaldoxime by the reduction of nitrates with oxygen in the presence of iron salts [$Fe(HCO_3)_2$] has been carried out by the writer experimentally. There is direct connection between the formation of these compounds and the formation of the aforementioned gases. The fact that soil bacteria (cholera bacilli also belong to this class) form the same gases which result from the reduction of nitrates in the presence of formaldehyde in sunlight, and the indication that formaldoxime is a product of bacterial activity and the photochemical reduction of nitrates with formaldehyde or with oxygen and iron lead to the conclusion that the chemical reduction processes in both cases are the same or are very similar. The bacteria, which do not need light, most probably use the energy of the iron peroxide in order to make nitrates available for building up proteins. It would be of the greatest interest to investigate whether nitrous oxide or nitrogen, with the help of complex iron salts and oxygen, can be linked in the inner sphere and thereby activated. Such experiments would lead to the still unsolved problems of the assimilation of free nitrogen by bacteria. I consider it to be

possible that many soil bacteria and also green leaves utilize nitrous oxide for nitrogen nutrition and, just as they absorb carbon dioxide, they absorb this gas and assimilate it from the air, where, as I found, it is formed continuously by the action of sunlight on nitrogen and oxygen. Nitrous oxide resembles carbon dioxide in its physical properties; according to Langmuir they are isosteric and isoelectric molecules. Experiments in the dark and in light with green plants and with soil bacteria exposed to an atmosphere of nitrous oxide or nitrogen, in combination with purely chemical experiments on the reaction of nitrous oxide with iron salts, should make it possible to obtain a better knowledge of the problem of nitrogen assimilation.

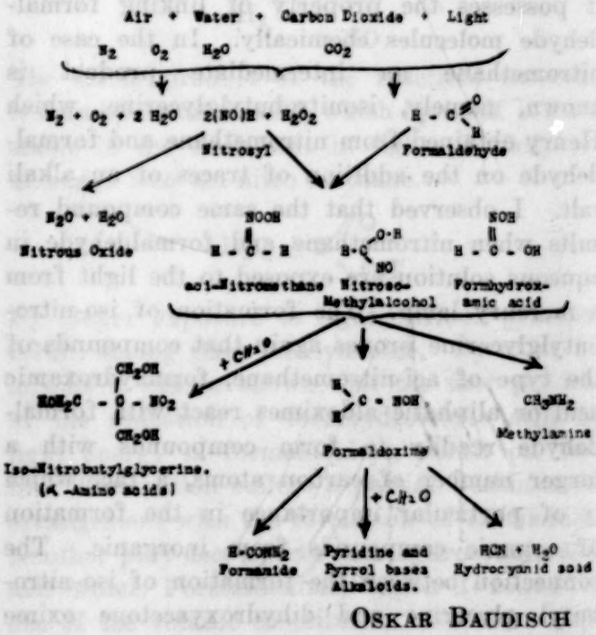
I shall now say just a few words on the reduction of carbon dioxide by light.

I believe that we are still far from the reduction, *in vitro*, of carbon dioxide to formaldehyde in large quantities by sunlight. The reduction of bicarbonates with mercury light gives only very small quantities of formaldehyde or sugar and it is questionable whether this process can be placed in parallel with the photochemical reduction of carbon dioxide in green plants.

It is quite different if the origin of the formation of organic compounds from inorganic is considered. Through exposure to intense ultra violet rays of very short wave length ($\alpha = 200\mu\mu$), such as one finds, for example, even at the altitude of the Monte Rosa peak, or by the influence of silent electric discharges, it has been shown that carbon dioxide is reduced to formaldehyde, and it is possible that this substance reacts with nitrous oxide formed from atmospheric nitrogen and oxygen to yield formhydroxamic acid. The synthesis of formhydroxamic acid from nitrous oxide and formaldehyde by exposure to sunlight has been carried out by the writer at the Mosso Institute on the Capanna Margheritta (4,600 m). There is as yet no basis for assuming that the formation of formaldehyde from carbon dioxide of the air and sunlight can be carried out at sea level without the aid of chlorophyll.

The formation of organic nitrogen containing substances from inorganic with the aid of light energy is, as you see, solved experimentally, and the methods which have been used lead to the assumption that organic substances found in nature may possibly be formed from air and light in the same or a similar manner. However, I am far from expressing the opinion that, in bacteria or in green plants, the synthesis of simple carbon and nitrogen containing compounds which I have outlined above is the correct one. E. C. C. Baly, who has repeated and extended my experiments, goes very far in his conclusions. For example, he writes the following sentence: "There is no doubt that formhydroxamic acid marks the first step in the phyto synthesis of the nitrogen compounds found in the plant." He proposes a table in which he begins with carbon dioxide and potassium nitrate and ends with proteins.

I believe that the further investigation of the synthesis of organic from inorganic compounds by light will lead to many interesting results, but the exact experimentation, with the isolation and analysis of the intermediate products, will require very great care on the part of the investigator. In sunlight at sea level most light reactions proceed extremely slowly and the secret of how green plants build up their protein from inorganic substances with the help of daylight will probably be unsolved for a long time.



OSKAR BAUDISCH
YALE UNIVERSITY

DINOSAURS AND COAL IN THE RED DEER COUNTRY, ALBERTA, CANADA[1]

IN the spring of 1884 I received instructions from the director of the Geological Survey of Canada to make a geological examination of the country between the Bow and Saskatchewan Rivers in what is now the province of Alberta. The area lay in a general way between north latitudes 51°, 30′ and 54°, and longitudes 110° and 115° west of Greenwich, embracing an area of about 45,000 square miles. This area covers the part of the valley of Red Deer River which has since proved to be the richest collecting ground for Dinosaurian bones in the world, and therefore a short account of their discovery may be of interest.

That western country was just beginning to be opened up. The Canadian Pacific Railway was built from Montreal to the Rocky Mountains, but it had not been connected through British Columbia to the shores of the Pacific. The townsite of Calgary had been decided on, but as yet the town consisted only of a few scattered houses, stores and stables in the vicinity of the railway station. A cable ferry, operated by current, made the crossing of the Bow River possible.

The Canadian government had adopted a regular system of survey for Manitoba and the North West Territory, consisting of meridian lines, run every fourth degree of longitude, between which base lines, nearly parallel to lines of latitude, were to be surveyed about twenty four miles apart. Between these base lines township boundaries were to be surveyed forming blocks six miles square, after which the included townships were to be subdivided into sections each a mile square. The surveys on this system had been begun, some of the base lines, as well as some of the township boundaries had been run, but no comprehensive maps had been prepared, and the maps with which I was furnished were based on a map made in 1813 by David Thompson, the old astronomer, surveyor and fur-trading partner in the North-West Company, with additions by Palliser and Hector in 1857 to 1860. It was therefore necessary for me while making geological investigations to do my own geographical surveys.

On the 12th of May I left Ottawa and on the 24th arrived at Calgary and proceeded to secure an outfit, the main items of which consisted of a wagon and buckboard, four or five horses, a canvas boat, tents, blankets and such like equipment. Rifles and shotguns must not be forgotten, for it was necessary for us to augment our food supply from the wild game of the country. In fact the expeditions of Dr. Dawson, Mr. McConnell and myself were at the time sometimes facetiously referred to in Ottawa as *Geological Cavalry*. My surveying instruments consisted of prismatic compass, odometer, to be attached to the wheel of the buckboard, tape line, watch, aneroid, sextant and artificial horizon.

To drive the team, pitch camp, do the cooking, etc., three men were engaged, two of them being halfbreeds and brothers named Mathew and Joseph Cook, and the other named Fitzpatrick, who had been in the American army in the west. Later in the year Mulligan and Gough were engaged to take the places of the Cooks.

In 1883, I had acted as assistant to Dr. G. M. Dawson on his geological survey of the Rocky Mountains and their eastern foot-hills, between the 49th parallel of latitude and the Bow River, but this was my first experience as the independent head of a geological survey party, and as we crossed the ferry on May 30th and drove out over the apparently limitless grass-covered plains, I could realize something of the feeling of the young mariner who wishes to sail his ship within sight of shore rather than strike out across the boundless ocean. At that time the whole country was a vast solitude, and one would travel for weeks at a time without seeing any white man, or in fact any human being.

After four days driving northward we arrived at the Red Deer River about eight miles, measured in a straight line, above the mouth of Paskapoo or Blind Man River. Red Deer River itself runs through the middle of the area which we were to explore, and consequently I thought it advisable to see it first in order to obtain a general impression of the work that was before me. Here sending two men with

[1] Read before Section of Geology of the American Association for the Advancement of Science on December 27, 1922.

the horses, buckboard and wagon to meet us at the mouth of Rosebud Creek, 120 miles farther down the stream, Mathew Cook and I took the canvas canoe and started down the river itself, keeping a rapid survey as we went. At the mouth of Blind Man River the brown sandstones of what I afterwards called the Pascapoo formation at the base of the Tertiary are very well exposed, while farther down the stream the white and light gray clayey sandstones, with coal seams, of what I afterwards called the Edmonton formation, at the top of the Cretaceous, compose the banks.

On June 9, after having spent a long and hot summer morning on the river, estimating the thickness of the various beds in the upper part of the Edmonton series, and endeavoring to correlate them one with another in the succession of cliffs as we passed down the stream, and their relation to two coal seams that could be detected now and then, Mathew Cook and I stopped for lunch on the east bank of the river under the shade of some cottonwoods, just south of north latitude 52°, in what is now section 11, township 35, range 21, west of the fourth Meridian. After lunch I walked eastward for three-quarters of a mile across the valley and climbed its eastern side. At an elevation of about 200 feet above the river, scattered among a large number of nodules and irregular masses of brown ironstone which formed conspicuous objects on the hillsides of white sandstone, I found and made a small collection of Dinosaurian bones, being the first of such bones found or collected in the valley of Red Deer River.

Next day we stopped for lunch beside the river where the steep sandstone banks of the valley are 300 feet high. Here Dinosaurian bones were again found to be abundant, and it was here that , five years later, Mr. T. C. Weston, the collector of the Geological Survey of Canada, found the second skull of *Dryptosaurus incrassatus*.

From there downwards similar bones were noticed in a number of places, being especially abundant on the steep hillsides east of the river, a short distance above the mouth of Knee Hills Creek.

On June 12, while passing the site of the present town of Drumheller, where now 1,000,000 tons of coal are annually mined; I landed on the north side of the river and examined and measured the seams outcropping there, and took a sample from the outcrop of the thickest seam. As far as I know that was the first time that these coal seams had been examined. In all probability coal is now the most important product of that district to the people living on the plains, but nevertheless the Red Deer valley is better known throughout the world for its Dinosaurs than for its coal.

After completing our canoe trip on the Red Deer River, we took the horses and drove in a wide circle, first eastward and then northward and northwestward to Edmonton, and then southward back to Calgary to refit and replenish our supplies. One evening, during the course of this journey we rode up to within a hundred yards of a herd of about twenty buffalo, probably one of the last herds of wild buffalo to come north into Canadian territory.

On July 22, we again left Calgary, and this time we first went westward up along the north side of Bow River into the foot-hills of the Rockies, thence we turned northeastward along the edge of the wooded country to the headwaters of Rosebud River, and thence we followed the banks of that river to its mouth in the Red Deer Valley, five miles below the site of the present town of Drumheller. On August 8, one of the last days of this trip, the axle of the wagon broke, and we were obliged to replace it by one hewn out of a green spruce tree. This served our purpose for a while, but we were always faced with the uncertainty of how long it would last, and the certainty that it would not last very long.

On August 11 we turned northward from Rosebud creek on an old Indian or halfbreed trail across the prairie. Following this for twelve miles we descended into the deep gorge-like valley of Knee Hills Creek, which we reached two and a half miles above its mouth, and a short distance below the mouth of Horseshoe Canyon, which joins the valley from the south. It was probably a mile or two below the station or siding of Gatine on the Drumheller branch of the Canadian Pacific Railway. The creek is about twenty-five feet wide and eighteen inches deep. We camped that night on a beautiful green sheltered flat with wood, water and grass in abundance to provide for the needs of ourselves and our horses. At and

near the bottom of the bank were fine large poplar trees, with a few spruce, while Service or Saskatoon berries and cherries were growing in great abundance. The banks of the valley were rocky, delighting the heart of the geologist who was sated with the undulating grassy plains, but it was too late to examine them that night.

The next day, however, I walked up the bank close to camp, and at an elevation of between forty and eighty feet above the creek found a number of Dinosaurian bones in an excellent state of preservation, though very brittle. Most of them were heavy and massive, such as those of the limbs, etc., but among these was a large and fairly perfect head of Laelaps (Dryptosaurus) incrassatus, a gigantic carnivore. We spent the afternoon excavating these bones from the rock, but unfortunately we had no appliances but axes and small geological hammers. We worked with all the care that the tools and the time at our disposal would allow, but in spite of all we could do some of the bones, teeth, etc., were broken. Then after we had managed to get them out of the rock, we had no proper means of packing them, and no boxes but the wagon box to put them in. However, we got together the skull and some of the best of the leg and other bones and then found that we had a heavier load than we were able to carry with us. We were therefore obliged to leave a small pile of bones at the bottom of the bank just north of the creek, on the chance that we might be able to pick them up at a later date, which fortunately we were able to do two months afterwards when returning from another expedition. After completing this work, and packing up our precious collection as well as we could, we started in a cold drizzling rain on our way to Calgary. First we were obliged to climb up to the top of the bank of the valley and it was so steep that with three horses we were not able to haul up much more than the empty wagon, while the fossil bones that we were able to take with us were packed up to the top of the bank on the backs of the horses.

Our journey to Calgary took us a week, for we were obliged to drive slowly and carefully, both on account of having the poor spruce axle in the wagon and because we were anxious not to jar the brittle Dinosaurian bones any more than necessary, though the riding could not be made very easy, since our course for the most of the way was over the rough unbroken prairie, and not on a road or trail. Our regular geological survey of the country passed through was also carried on as usual, for an exploring geologist rarely ever has the opportunity of seeing a particular place or tract of country twice. This survey included an examination of the banks of the valley of Knee Hills Creek from our Dinosaur camp upwards, for they furnish an excellent series of sections of the Edmonton and lower Pascapoo rocks. While making this examination of the valley, and when at a point about five miles above Dinosaur camp, we found one end of a large limb bone, the piece preserved being twenty-six inches long, four and a quarter inches across the middle of the shaft, and eight and one half inches across the end or head.

At Calgary the bones were packed in boxes and shipped to the director of the Geological Survey in Ottawa, whence they were sent to Professor Cope in Philadelphia for examination and description. The skull, along with another similar one obtained by Mr. T. C. Weston in 1889, who was sent out on my suggestion and solicitation by the director of the Geological Survey of Canada, for the especial purpose of collecting Dinosaurian bones in the same vicinity, was described by Professor Cope, and afterwards with illustrations by Mr. L. M. Lambe, but the other bones were probably not sufficiently perfect for identification, and as far as I know have never been described.

After the collection was shipped, I started back with the little party of men and horses to continue the exploration of the district allotted to me.

J. B. TYRRELL

EXPLOSIVE ERUPTIONS OF KILAUEA

OWING to the spectacular character of the fire fountains of Kilauea, but little attention seems to have been given to the evidences of explosive eruptions of the genuine Vesuvian type, and this volcano has become known for quiet, well-ordered activity. Some recent field studies of the writer indicate that there are evidences of four explosive eruptions, probably separated by considerable time intervals,

two of the centers of activity being in the northern and two in the southern sections of the great crater. The fire pit of Halemaumau seems to serve as a safety valve for the escape of the gases held in solution by the molten lava, but when this pit freezes over and these gases accumulate, sufficient pressure beneath the crust is violently shattered and the more or less comminuted fragments and effervescing lava are hurled into the atmosphere. The coarser blocks and bombs settle first and for the most part nearer the vent, while the finer fragments making up the gravel, lapilli, sand and dust are deposited in succession, giving rise to a more or less well-defined stratification as viewed in vertical section. If the wind is active at the time of the eruption, the lighter and finer materials will be drifted to considerable distances and each stratum will show the heavier and coarser material toward the vent, passing radially into the lighter and finer deposits, thinning more or less gradually and finally becoming indistinguishable from the subjacent deposits.

In addition to the four above mentioned explosive eruptions there is evidence of a fifth of very minor character supplied by witnesses who furnished the earliest written descriptions of this volcano (Ellis, Loomis, Stewart, 1823-1825). The activity seems to have culminated in 1825 about the time of the visit of Lord Byron, when "red-hot stones, cinders and ashes were also propelled to a great height with immense violence." The records since this date indicate no such explosive activity, but a welling up of the molten lava, accompanied often by much vigorous fountaining and ending in an overflow over the floor of the great crater (1844, 1849, 1868, 1918 and 1921), an escape into adjacent minor craters (1832, 1922), an outbreak through fissures in the sides of the Kilauean mass (1840, 1868) above sea level or as a submarine flow as apparently occurred in 1849 and 1884. Only once in the entire history of the volcano has it been known to overflow the rim of its crater and this to only a trifling extent as recently as March, 1921.

The first of the series of explosive eruptions of which we have any present evidence took place so long ago that nearly 500 feet of successive lava flows overlie the stratum of fragmental matter ejected at the time. Judging from the present slow rate of pericentric outpourings and the small average thickness of these overlying layers, this would call for a great period of time as measured in years. But conditions may be readily imagined under which this time would be greatly reduced. This eruption began apparently with the ejection of dust and sand and was followed by lapilli, some bombs and large and small blocks. No trace was found of the dumb-bell or Indian-club droplets or of that peculiarly light form of pumice known locally as "limu," or the "thread lace scoria" of Dana. This stratum is to be seen only in the northwest quadrant of the crater wall, and in the last few years much of it has been covered by recent outpourings from Halemaumau. Between this first of which we have record and the above mentioned fifth, which left nothing of a recognizable nature, we find evidence of three other violent eruptions.

The number four of the series was the locally well-known eruption of 1789-90 which annihilated a division of Keoua's army bivouacing in the vicinity. Native eye witnesses reported that the eruption was preceded by violent earthquake shocks, terrific thunder and lightning, when a dense cloud of darkness rose from the crater and enveloped the entire region. Showers of sand and cinders soon began to fall and these were followed by coarser fragments, some of which were glowing and occasionally bursting with loud report. The deposit from this eruption was concentrated mainly about the southeastern quadrant of the crater and appears to have not come from Halemaumau, but from somewhat nearer the center of the main crater. The maximum thickness observed was about 12 feet, and the deposit contains little dust and sand, consisting in the main of unconsolidated material which would ordinarily pass as gravel. The direction of the wind seems to have been mainly from the northwest, finally shifting around to the northeast, and carrying south-westward quantities of limu. Bombs ranging from the size of unhulled walnuts to the size of a head are found rather abundantly, and the eruption ended apparently with a terrific shower of lava blocks which fell upon a crusted sur-

face which to this day retains the impact basins resulting from their fall.

Lying unconformably beneath this relatively recent material and separated from it by erosion surfaces and in some cases thin lava flows, we find the deposits of two apparently separate eruptions which we designate as second and third in the series. They were both characterized by the ejection of quantities of volcanic ash, concentrated about the northeast and southeast quadrants of the crater respectively and extending some three or four miles beyond the rim so far as appreciable deposits are concerned. The older of the two started with a small amount of fine ash and then with quantities of the thread-lace scoria of the most perfect type and a peculiar type of dumb-bell and Indian-club droplets; so far as known formed only at this time, probably because of some peculiar consistency of the magma. This deposit is that seen about the Volcano House and the roadway leading east and west. In the crater itself the deposit attains a thickness of twenty-five to thirty feet. Wherever observed the basal layer was found to carry more or less of the perfect type of thread-lace scoria, quite readily distinguished under the magnifier from that ejected in 1789, as well as the recent samples collected by Jaggar from Mauna Loa. This eruption closed as did that of 1789 with the discharge of many volcanic blocks, large and small, directed mainly to the northwest for a distance of two to three miles from the rim. Superficial field observations indicate that these blocks have been longer exposed to the weather than have those of 1789, and that they bear a relationship to the dike material found in the adjacent crater wall.

The deposits of the third eruption of the series are for the most part fine and very perfectly stratified. Bombs and blocks are rarely seen and no limu or droplets characterize the sections. The eruption began apparently with the ejection of a black sand, which fell upon a weathered and rusted surface of pahoehoe. This was followed by clouds of fine dust, attaining a maximum thickness about the southeastern quadrant of the crater of some forty-five feet. Along the extended minor, or east-west axis of the crater, these deposits overlap those of the second eruption, if we are justified in attaching correlation value to the true thread-lace scoria. However, in the crater they are much more firmly indurated than the latter, through the action of steam and other gases and hence have the appearance of greater age.

During certain stages of this eruption, as well as that of the second and fourth in our series, rain drops falling through the hot, dust-laden atmosphere became completely charged with the fine dust, arranged in concentric shells and slightly cemented and dropped into the soft ash layer beneath without undergoing appreciable distortion. Some of these are still firm enough to be rolled along and segregated like pebbles by temporary rills. Similar bodies fell abundantly in the vicinity of Naples on the morning of April 8, 1906, Vesuvius being then in eruption (Bassani and Galdieri). Specimens from Kilauea were photographed by Perret in 1914 and referred to by Friedlander under the term "pisolites." Is there any serious objection to calling them fossil rain drops? During the closing stages of the second eruption these pellets grew to the size of one's thumb, as in the case of ordinary hail stones, as suggested by Lane, and were slightly flattened by their fall or possibly manner of formation. To the west and northwest of the main crater, beyond the limits of the coarser debris, these remarkably preserved structures may be collected by the bushel.

W. H. SHERZER

MICHIGAN STATE NORMAL COLLEGE,
YPSILANTI, MICHIGAN

SCIENTIFIC EVENTS

THE PI MU EPSILON MATHEMATICAL FRATERNITY

IN these days of the extreme emphasis on and acclaim accorded to athletic prowess, it was but natural that scholars in their different fields should establish honors and emoluments for the recognition of mature and successful scholars and for the encouragement of younger aspiring scholars that should challenge, encourage and reward their intellectual prowess. Among such means of honor and encouragement are honorary national fraternities in special fields of scholastic endeavor. The basis of membership in these fraternities is scholarship.

It is not surprising therefore that such a national fraternity has been established for mathematicians. This fraternity had its birth at Syracuse University. The Mathematical Club of Syracuse University was organized in 1903. After it had had ten years of successful existence, it was entirely reorganized and became the first chapter of the Pi Mu Epsilon Mathematical Fraternity, which was founded at Syracuse University and incorporated on the twenty-fifth of May, 1914, at Albany, under the laws of the state of New York. "Pi Mu Epsilon is an academic fraternity in institutions of university grade," says the constitution. Its primary aim is the advancement of mathematics and scholarship. While its members are elected entirely on the basis of scholarship in mathematics and other subjects, it is not merely an honorary fraternity in that election to membership is all there is to it. It is a living, active, working fraternity of scholars, in which the members are actively engaged in study and research in the preparation of papers in the field of mathematical science to be presented at its regular meetings.

The following classes are eligible to membership in Pi Mu Epsilon: Any one whose work in the mathematical sciences is distinguished; members of the mathematical faculty; major and minor graduate students of mathematics; any former graduate whose work in mathematics was or is distinguished; major and minor undergraduate students of mathematics who attain the standard of scholarship set by the fraternity for eligibility to membership of such undergraduates.

One of the features of the fraternity's activity is the preparation on the part of each chapter of a circular letter to be sent to all the chapters at least once a year, and containing items of interest concerning its work and programs and list of officers, in order that, according to the constitution, "the chapters may realize the benefits of that fraternal interaction and stimulus, which was one of the reasons for founding the fraternity."

The fraternity now has six chapters, in the order of their installation, at Syracuse University, Ohio State University, University of Pennsylvania, University of Missouri, University of Alabama, Iowa State College of Agriculture and Mechanic Arts.

The national officers of the fraternity are: *Director general,* Professor E. D. Roe, Jr., Syracuse University; *vice-director general,* Mr. William V. Houston, Ohio State University; *secretary general,* Professor Warren G. Bullard, Syracuse University; *treasurer general,* Miss Louisa S. Lotz, University of Pennsylvania; *librarian general,* Miss Mabel G. Kessler, University of Pennsylvania.

E. D. ROE, JR.

THE ARNOLD ARBORETUM OF THE HARVARD UNIVERSITY

THE committee appointed by the Board of Overseers of Harvard College to visit the Arnold Arboretum has issued the following statement:

The arboretum was established fifty years ago as the university's museum to increase the knowledge of trees and shrubs, of which it has now the largest living collection in America, supplemented by a great herbarium and library, and is everywhere recognized as the most important institution of its kind in the world, and also as one of the most beautiful of all public gardens. For forty years it has been the most active and successful of the agencies for the discovery and study of new trees and shrubs; and to-day it is a great national institution of world-wide usefulness and reputation, to whose initiative and example the parks and gardens of America owe much of their beauty.

The arboretum has outgrown its endowment, which produces only $40,000 a year, and to meet the deficits of income the director has been obliged for a long time personally to raise every year from forty to fifty thousand dollars, which have been given usually by not over one hundred and twenty persons chiefly living in Greater Boston. A still larger income will be required if the arboretum is to broaden its influence and maintain its position. Professor Charles S. Sargent has been director of the arboretum for fifty years, and it is time that he should be relieved of this burden of money-raising.

A national institution is entitled to national support. Will you not contribute $10 or such larger sum as you feel able to give for the work of the arboretum? Every contributor will receive in return the arboretum's *Bulletins of Popular Information,* containing information about all new and interesting plants, the illustrated guide to the arboretum, if desired, and any assistance and advice about his own plants that can be furnished by correspondence.

The visiting committee consists of Roger Wolcott, William C. Endicott, Theodore A. Havemeyer, Mrs. L. A. Frothingham, Charles L. Hutchinson, Richard T. Crane, Jr., Henry F. du Pont, Galen L. Stone, Henry S. Hunnewell, Albert C. Burrage, John E. Thayer, Mrs. Harold I. Pratt and Henry H. Richardson.

THE ELECTRON IN CHEMISTRY

SIR JOSEPH THOMSON gave a course of five lectures on "The electron in chemistry" before the Franklin Institute, Philadelphia, during the week of April 9. The topics treated were as follows:

Lecture 1: The atomic theory had little effect on the progress of chemistry as long as nothing was known about the structure of the atom. The discovery of the electron showed that atoms have a structure and gave a clue to its character. The arrangement of the electrons in the atom. Number of electrons in the atom. Electronic isomers. Active nitrogen. Instability of configuration when electrons are too crowded. Eight the maximum number of electrons which can be on the outer layer of an uncharged atom. This result involves a periodicity in the properties of the atoms of the different elements, such as is expressed by Mendeleef. Periodic law. Valency. The size of atoms. Specific inductive capacity. Work required to abstract an electron from an atom. Methods for testing the configuration of electrons in an atom.

Lecture 2: The combination of atoms to form molecules. Physical interpretation of chemical "bonds." Double bonds. Union of two similar atoms to form a molecule. Union of two or more dissimilar atoms. "Positive and negative" valencies. Arrangement of electrons in octets. Comparison with the results of the old valency rules. Stability of systems of octets. Instability chains in octets in general. Stability of CH_2 chains. Polar molecules. Importance of these in chemical reactions. Problem of the water molecule. Arrangement of the electrons in chlorides, chlorates, perchlorates, carbonates, sulphates, sulphites, nitrates, nitrites. Connection between the arrangement of the electrons and the acidic or basic properties of the compound.

Lecture 3: Mechanism of chemical combination. Active molecules. Their occurrence in such reactions as the combination of hydrogen with chlorine or of oxygen with hydrogen. Afford a physical basis for Thiele's theory of partial valencies. "Molecular compounds." "Residual affinity." Double salts. Electron theory gives a physical basis for Werner's coordination theory. Mechanism of electrolytic dissociation. Structure of the ions in liquids. Catalytic action. Variable valency and homologous elements.

Lecture 4: Connection between variable valency and the magnetic properties of the elements. Magnetism of chemical compounds. Magnetism of oxygen. Dia-magnetism affords a method of checking the configuration of the atom and the migration of the electrons in chemical combination. The electron theory of solids. General considerations. Calculation of the energy of a solid.

Lecture 5: The calculation of the electron theory of the compressibility of the elements in a solid state. Critical periods of vibration for solids. Latent heat of evaporation. Compressibility and specific inductive capacity of salts. The structure of metals, salts and insulators. Electrical conductivity of metals.

PRESENTATION OF THE JOHN SCOTT MEDAL AWARDS

THE City of Philadelphia, through its board of directors of city trusts, made the annual presentation of the John Scott Medal Awards at a special meeting of the American Philosophical Society on the evening of April 10. The awards were as follows:

To Sir Joseph Thomson, O.M., F.R.S., master of Trinity College, Cambridge, for his researches on the physics of the electron.

To Francis William Aston, D.Sc., F.R.S., of Trinity College, Cambridge, for his development of the mass-spectrograph and his studies of isotopes; to be received by his Excellency the British Ambassador or his representative, H. C. Chilton.

To C. Eijkman, M.D., of the University of Utrecht, for his researches on dietary diseases; to be received by His Excellency the Minister from the Netherlands.

To Arthur Louis Day, Ph.D., Sc.D., director of the Geophysical Laboratory of the Carnegie Institution of Washington, for his researches on optical glass.

Dr. Hobart A. Hare represented the board. Responses were made by Sir Joseph Thomson, by Mr. H. C. Chilton on behalf of the British Ambassador for Professor Aston, by the Minister from the Netherlands for Professor Eijkman, and by Dr. Day.

The awards are made annually by the City of Philadelphia from the income of the John Scott fund upon recommendation of an advisory committee of five, consisting of representatives from the National Academy of Science, The American Philosophical Society and the University of Pennsylvania. The former body is represented by William B. Scott, of Princeton; Theobald Smith, of Princeton, and Henry H. Donaldson, of the Wistar Institute, Philadelphia; the American Philosophical Society by Samuel M. Vauclain, of Philadelphia, and the University of Pennsylvania by Arthur W. Goodspeed, of Philadelphia.

SCIENTIFIC NOTES AND NEWS

GEORGE LINCOLN GOODALE, professor of botany at Harvard University from 1873 until his retirement as professor emeritus in 1909, president of the American Association for the Advancement of Science, died on April 12, in his eighty-fourth year.

ALICE CUNNINGHAM FLETCHER, assistant ethnologist of the Peabody Museum, Harvard University since 1882 and the holder of the Thaw fellowship of the museum since 1891, has died, aged seventy-seven years.

THE University of Pennsylvania, at a special convocation on April 11, conferred the honorary degree of Doctor of Science on Sir Joseph Thomson, master of Trinity College. Sir Joseph, after concluding his lectures before the Franklin Institute, returned to Engand on April 14 on the *Homeric*.

IN the Paris Academy of Sciences M. Louis Gentil, professor of physical geography at the Sorbonne, has been elected to succeed the late M. Favé. M. Gabriel Bertrand, professor of biological chemistry at the Sorbonne and the Pasteur Institute, has been elected to succeed the late Georges Lemoine.

IT is stated in *Nature* that the Mueller medal and fund have been awarded to Mr. J. H. Maiden, government botanist of New South Wales and director of the Botanic Gardens, Sydney, in recognition of his botanical work. The medal was founded in memory of the late Baron von Mueller, government botanist of Victoria, and is awarded at each meeting of the Australasian Association for the Advancement of Science which this year met at Wellington, New Zealand.

FOUNDERS' Medal of the Royal Geographical Society has been awarded to Knud Rasmussen, the Danish explorer, for his explorations and research in the Arctic in the last twenty-five years.

THE University of Manchester will confer its honorary doctorate of science on Professor Niels Bohr, Copenhagen; Professor F. G. Hopkins, Cambridge; and Mr. W. B. Worthington, president of the Institution of Civil Engineers, 1921-1922.

DR. W. A. MURRILL, supervisor of public instruction at the New York Botanical Garden, with which he has been connected for 20 years, has been awarded a gold medal by the Holland Society of New York, for his distinguished service in the science of mycology. The presentation took place at the meeting of the society in the Hotel Astor on April 6, and was followed by an address by Dr. Murrill on "Fungi and their relation to forestry."

AT the annual meeting of the Chemical Society of Great Britain Professor W. P. Wynne, Firth professor of chemistry in the University of Sheffield and dean of the faculty of pure science, was elected president for the ensuing two years to succeed Sir James Walker, who addressed the meeting on "Symbols and formulae." There were present Professor Henri Le Chatelier, representing la Société Chemique de France, and M. Paul Kestner, representing la Société de Chimie Industrielle.

A NUMBER of chemists of the Northeastern Section of the American Chemical Society entertained at dinner on April 7, at the University Club, Boston, J. C. Irvine, principal and vice-chancellor, University of St. Andrews; F. G. Donnan, professor of physical chemistry, University College, London; Th'e Svedberg, professor of physical chemistry, University of Upssala, and Professor E. C. Franklin, of Stanford University, president of the American Chemical Society.

DR. ALICE HAMILTON, assistant professor of industrial medicine at Harvard University Medical School, Boston, was the principal speaker at the annual meeting and banquet of the Chicago Tuberculosis Institute held in Chicago on March 26.

GRANTS from the Gordon Wigan fund of the University of Cambridge have been made to Professor Punnett for plant-breeding experiments, to the Museum of Zoology for cases, to Professor Gardiner for a centrifuge and incubator, to Mr. Harker for sections of rocks, and to Professor Seward for sections of fossil plants.

THE British Secretary for Mines has appointed Sir Frederick L. Nathan, Mr. J. D. Morgan, Mr. W. Rintoul and Professor R. V. Wheeler to be a sub-committee of the Explosives in Mines Research Committee to carry out investigations on the means employed for firing explosives.

COLONEL P. KOZLOFF, the Russian explorer of Inner Asia and holder of the Founder's Medal of the Royal Geographical Society, is about to start on a three years' expedition to Tibet and adjacent regions.

MR. G. H. WILKINS, the naturalist of the *Quest*, arrived in Melbourne in the middle of March to lead the British Museum exploration expedition which is to visit Northeast Australia and then New Guinea to study the flora and fauna.

MR. NEIL M. JUDD, curator of American archeology in the U. S. National Museum, will leave Washington May 1 to resume direction of the National Geographic Society's expedition for the exploration of Pueblo Bonito, one of the largest and best preserved prehistoric ruins in the southwestern United States. This exploration is now in its third year; it is expected that the investigations will have been concluded late in 1925. Mr. Judd's staff this year will include assistants, and, as heretofore, experts will participate in the annual symposium to be called at the close of the excavating season. A force of twenty Indians, both Navaho and Zuñi, will be employed in the operations.

DR. ELLSWORTH HUNTINGTON, president of the Association of American Geographers and research associate in geography at Yale, has been granted a leave of absence from the university for the first term next year. He is leaving New Haven on May 22 for Japan and China, and will later go to northern Australia, where he will study tropical conditions. He will attend the Pan-Pacific Scientific Congress which will be held in Sydney and Melbourne, beginning August 13, and will then carry on his investigations in the deserts of Australia. Before returning to the United States at the end of the year for the meetings of the Association of American Geographers, Dr. Huntington will visit the East Indies and will study the ruins in Indo-China, comparing them with those in Guatemala.

DEAN HENRY P. TALBOT of the Massachusetts Institute of Technology has been granted a leave of absence until next September. During his leave he expects to visit a number of colleges including Princeton, University of Pennsylvania, Johns Hopkins, University of Virginia, Tulane University, Georgia School of Technology, Rice Institute, California Institute of Technology, University of California, Leland Stanford, University of Oregon, Reed College and University of Washington. Mrs. Talbot will accompany him. During his absence Harold E. Lobdell, assistant dean, will act in his stead.

FOLLOWING the meeting of the American Chemical Society at New Haven Professor G. Bruni, of the University of Milan, lectured on April 9 at Columbia University on "Theoretical and practical rubber chemistry"; on April 12, before the Pittsburgh Section of the American Chemical Society, on "Italy's part in chemical scientific development," and on April 13, at Ohio State University on the same subject.

LAFAYETTE B. MENDEL, professor of physiological chemistry at Yale, left New Haven on April 6 for the Pacific Coast. As has already been reported in SCIENCE, he will deliver lectures at the University of California on the Hitchcock Foundation, his general subject being "Nutrition", and will also lecture at other places. He has leave of absence from Yale for the balance of the college year.

DR. W. D. MATTHEW, F. R. S., curator of the department of paleontology, American Museum of Natural History, delivered an address on March 10 at Toronto to the Royal Canadian Institute on the subject, "Ancestry of the horse and other geological records of evolution."

DR. MILTON J. ROSENAU, professor of preventive medicine and hygiene at Harvard University, gave a lecture on March 12 before the Wisconsin Branch of the Society of American Bacteriologists on "Food poisoning." This was followed by a dinner at which Dr. Rosenau spoke about his experiences in the famine district of Russia.

DR. A. J. DEMPSTER lectured at the University of Iowa on March twenty-sixth on the subjects "Light emission in canal rays" and "Isotopes.".

DR. LOUIS A. BAUER, director of the Department of Terrestrial Magnetism, gave on March 31 an illustrated talk at the General Electric Company, Schenectady, N. Y., on "The present status of our knowledge regarding the constitution and causes of the earth's magnetic field." He also gave a talk on "The earth's magnetism" at the General Electric Company, West Lynn, Massachusetts, on March 30.

AT the February meeting of the Research Club of the University of Vermont, Dr. M. B. Cummings, of the department of horticulture, addressed the club on "Sterility in plants."

PROFESSOR WALTER B. PILLSBURY, who has leave of absence as head of the department of psychology in the University of Michigan, has been lecturing at Montpelier, France, where he delivers a series of eighteen lectures. Professor Pillsbury expects to lecture in Paris the latter part of May. From Paris he will go to England. He will probably return to the university in time for the opening of the first semester next fall.

DR. SVEN HEDIN lectured on "The great desert of Asia" at Clark University on March 26. He has also been lecturing in Boston and other New England cities.

T. ALEXANDER BARNS, explorer and author of "The Wonderland of the Eastern Congo," has arrived in the United States to lecture on his experiences in the Congo and on the opportunities offered by that country. His first lecture was before the National Geographic Society in Washington.

DR. A. H. COMPTON, head of the department of physics, Washington University, St. Louis, lectured before the graduate students in physics at the University of Iowa on April 4 and 5 on "Some problems in the study of X-rays" and "A quantum theory of X-ray scattering".

DR. DAVID MARINE, of the Montefiore Hospital, New York city, will deliver the eighth Mellon lecture entitled "The importance of our knowledge of thyroid physiology in the control of thyroid diseases", before an open meeting of the Society for Biological Research of the Medical School, University of Pittsburgh, on the evening of May 10, 1923.

DR. JOHN MERLE COULTER, of the University of Chicago, was the guest of the Scientific Club of the College of Wooster on April 4. He gave a public lecture under the auspices of the club on "Evolution and religion". He also addressed the students of the botany department, giving them an interesting account of his experiences as botanist of the Hayden expedition in 1872, when it explored and mapped the geyser region of the Yellowstone. He also appeared before the staff of the Ohio Agricultural Experiment Station, speaking on "The botanical opportunity".

THE following public lectures are being given this spring at the Brooklyn Botanic Garden: April 13, "Trees in nature and art," Dr. A. F. Blakeslee, resident investigator in plant genetics, Station for Experimental Evolution, Cold Spring Harbor, L. I. April 20, "Forestry in the United States," Professor Henry Solon Graves, dean, School of Forestry, Yale University. April 27, "What's new in the garden," Mr. Edward I. Farrington, editor of *Horticulture*, Boston, Mass.

THE death is announced on March 18 of Sir William Thorburn, emeritus professor of clinical surgery in the University of Manchester.

DR. JAMES GOW, formerly headmaster of Westminster School, London, and author of "A short history of Greek mathematics" and of texts on the classics, died on February 16.

Nature records the deaths of the Rev. Wil-

liam Wilks, formerly vicar of Shirley, Croydon, known to scientific men for his work in horticulture, and of Sir Ernest Clarke, long secretary of the Royal Agricultural Society of England.

BY his will Professor Edward Emerson Barnard, for more than twenty-five years on the staff of the Yerkes Observatory, has bequeathed to the University of Chicago his astronomical books and to the observatory the medals that have been given him for astronomical work, as well as the small astronomical instruments now on exhibition in the observatory. To the university Professor Barnard has given his home and the grounds which belong to it which adjoin the grounds of the Yerkes Observatory, to honor the memory of his wife, Rhoda Calvert Barnard. Among the medals awarded to Professor Barnard for his work in practical astronomy are the Lalande, the Arago, and the Janssen gold medals from the French Academy of Sciences; the gold medal of the Royal Astronomical Society of Great Britain; and the Bruce gold medal of the Astronomical Society of the Pacific.

THE tricentenary of the birth of Blaise Pascal occurs on June 19, and according to *Nature* preparations have been made for celebrations in France on July 8-9. The President of the French Republic will attend the meetings, the chief of which will be a commemoration gathering, to be addressed by the Minister of Public Instruction and other members of the French Academy. There will also be a meeting at the summit of the Puy de Dôme, when a member of the Academy of Sciences will speak on the famous experiment carried out there, at Pascal's suggestion, of observing the barometric height at the summit and comparing it with that at the base of the mountain. A difference of three inches in the height of the mercury column was observed, giving Pascal justification for his conclusion that the column of mercury in the barometer is supported by the pressure of the atmosphere.

THE Paris Academy of Sciences has received a bequest of 750,000 francs from the late M. Massin, to establish a fund the income of which is to be used for the advancement of science.

FOR the observation of the solar eclipse on Catalina Island, California, September 10, 1923, a fund of $5,000 has been provided by Mr. William Wrigley, Jr., of Chicago, to finance the expedition, which will be under the supervision of Director Edwin B. Frost, of the Yerkes Observatory.

THE forty-third semi-annual meeting of the American Electrochemical Society will be held at the Hotel Commodore, New York City, from May 3 to 5. The technical program will include a whole-day session on the general topic "The production and application of the rarer metals." The arrangements for this session are in charge of Dr. F. M. Becket, of the Electrometallurgical Corporation, New York City. Another session will be devoted to a discussion of "Electrode potentials," led by Dr. William G. Horsch of the Chile Exploration Company, New York.

AT an adjourned meeting held in the rooms of the Royal Society in March, the Conjoint Board of Scientific Societies was formally dissolved. In view of this step, which became inevitable towards the end of last year, when the Royal Society withdrew its support, the work done by the various committees of the board has been terminated, and the World List of Scientific Periodicals had been vested in Dr. Chalmers Mitchell, Sir Robert Mond and Sir Arthur Schuster, as trustees.

SIGMA XI fellowships of a minimum value of $1,200 for the coming academic year are to be awarded on May 18. The fellowships are available for workers in other fields than physics, chemistry and the medical sciences. Preference will be given to candidates who have already taken their doctor's degree. Men and women are eligible. Applications should be accompanied by reprints of publications, letters from those competent to pronounce upon the ability of the candidate, a statement of the work the candidate proposes to do on this award and where such work is to be done. The fellowships carry no restrictions as to university or country. Applications must be made before May 15 and should be addressed to Dean Edward Ellery, Union College, Schenectady, N. Y.

THE Committee on Therapeutic Research of the Council on Pharmacy and Chemistry of the

American Medical Association will consider applications for grants to assist research in subjects which, in the opinion of the committee, are of practical therapeutic interest to the medical profession, and which research might not otherwise be carried out because of lack of funds. Requests should state the specific problem which is to be studied, the qualifications of the investigator, the facilities available to him, and, if work is to be undertaken in an established research institution, the name of the individual who will have general supervision. The committee will also appreciate offers from research workers to undertake investigations of questions which may be suggested by the council. Applications should be addressed to: Chairman, Therapeutic Research Committee, Council on Pharmacy and Chemistry, 535 North Dearborn Street, Chicago, Illinois.

THE American Pharmaceutical Association has available a sum amounting to $400 which will be expended after October 1, 1923, for the encouragement of research. Investigators desiring financial aid in their work should communicate before June 1 with H. V. Arny, chairman of the research committee, 115 West 68th St., New York, giving their past record and outlining the particular line of work for which the grant is desired.

WE learn from *Nature* that the Geological Department of the British Museum (Natural History) has acquired the paleobotanical collection of Dr. Dukinfield H. Scott. It comprises more than 3,000 microscopic slides, chiefly of British Carboniferous plants, on which most of Dr. Scott's own researches have been based. It is a direct continuation of the Williamson collection which was acquired by the museum in 1896.

THROUGH the kindness of Miss Ellen B. Scripps, Pomona College of Claremont, California, has purchased the herbarium of Marcus E. Jones of Salt Lake City, Utah. This collection is one of the most complete herbaria ever made for the arid regions of western North America and represents the accumulation of forty-five years of botanical activity on the part of Professor Jones. It contains about 200,000 sheets. In making his collection, Professor Jones has had the ecological point of view and has taken material so as to show the range of variation of the species included, in a very satisfactory way. Professor Jones accompanies the herbarium to its new destination. This herbarium, coupled with the C. F. Baker herbarium of about the same size, gives Pomona College one of the most important western collections. Botanists desiring to consult material should communicate with Dr. Philip A. Munz, Claremont, California.

A CORRESPONDENT writes: "While in Japan last October and November, Dr. David Starr Jordan made again a large collection—the third in his travels—of the fishes of Japan. The Imperial Universities took great interest in this collection and the Imperial University of Tokyo sent Professor Shigeho Tanaka to the extreme north of Japan and Dr. Yoshiro Wakiya to the south of Japan, while the veteran collector, Kuma Aoki, was directed to secure again everything possible from Sagami Bay, a sheet of water, which, thus far, has yielded more species of fishes and particularly of sharks than any other bay whatsoever. The Imperial University of Kyoto empowered Professors Kawamura and Yamamoto to be of all assistance possible, while the Imperial University of Sapporo in the far north sent out Messrs. Majima and Takayasu to examine the markets of the northwest and the northeast of the island of Hokkaido. Professor Ishikawa of the Imperial University of Tokyo also selected series of duplicates from the different universities. In all, four or five hundred species were obtained, some thirty-five of them new to science."

THE new motion picture film, "Evolution, from the birth of planets to the age of man," was shown on Friday, April 6, and again on Sunday, April 8, at the Brooklyn Botanic Garden. In addition to the public presentations, a special showing for biology students of the Brooklyn high schools was held on Friday, April 6. The film has been produced by Dr. Raymond L. Ditmars, of the New York Zoological Garden and edited by Dr. Benjamin C. Gruenberg.

A BILL introduced in the Arkansas legislature prohibiting the teaching of Darwinism, or any other form of evolution, in the public and state supported schools passed the house with practically no opposition but failed in the senate.

UNIVERSITY AND EDUCATIONAL NOTES

PRINCETON University will, subject to a life interest, receive over $500,000 by the will of Charles F. Williams.

MRS. GEORGE CHASE CHRISTIAN, of Minneapolis, has given $250,000 to establish an institute at the University of Minnesota for the investigation and treatment of cancer.

GOVERNOR BAXTER has signed a bill appropriating $895,000 to the University of Maine. The sum of $300,000 is appropriated for each of the fiscal years ending 1924 and 1925. For repairs and equipment $75,000 is provided for the first of the two years and $50,000 for the second. For an arts and science building $170,000 is appropriated, the expenditure to cover the two years.

DR. SAMUEL WESLEY STRATTON, president of the Massachusetts Institute of Technology, will be formally inaugurated on June 11.

DR. OSKAR KLOTZ, recently engaged in reorganizing the pathological department of the University of Buenos Aires, under the direction of the Rockefeller Foundation, has been appointed to the chair of pathology of the University of Toronto Faculty of Medicine, left vacant by the death of Dr. John J. MacKenzie.

MR. W. J. PERRY has been appointed to a university readership in cultural anthropology and Dr. Bronislaw Malinowski to a readership in social anthropology in University College, London.

PROFESSOR A. V. HILL, of Manchester, has been appointed to the Jodrell chair of physiology in University College, London.

DISCUSSION AND CORRESPONDENCE

EINSTEIN DISPLACEMENT ON THE PLATES TAKEN BY THE CANADIAN PARTY AT THE AUSTRALIAN ECLIPSE

AT the eclipse of the sun of September last two plates were taken to test for the Einstein effect, by the Canadian party at Wallal, western Australia. The focal length of the camera was eleven feet and the aperture of the lens was six inches. Dr. R. K. Young, of the Dominion Astrophysical Observatory, Victoria, B. C., who was a member of the party, has completed the measurement and computation of the plates, and the final results are given below. Over thirty stars were recognized on the plates and twenty-three were submitted to measurement, but eight of these were discarded in the course of the work, thus leaving fifteen. The measured displacement outward from the sun, as well as the expected amount according to Einstein's theory, are given in seconds of arc:

Measured +0.30, +0.44, +0.28, +0.25, +0.66, +0.22, —0.31, +0.12, —0.11, +0.23, +0.08, +0.06, +0.53, +0.77, —0.05.

Expected +0.48, +0.41, +0.40, +0.30, +0.28, +0.27, +0.24, +0.24, +0.24, +0.22, +0.22, +0.21, +0.21, +0.21, +0.18.

It will be seen that the displacement is undoubted and its amount is approximately that predicted by Einstein, but the results can hardly be considered decisive.

C. A. CHANT

UNIVERSITY OF TORONTO,
APRIL 7, 1923

FUNDAMENTAL CLASSIFICATION OF GALLS

IN the interest of gall science, attention is called to the following errors and deficiencies appearing in a recent number of SCIENCE which are related to the definition of two basic and highly significant terms.

Cook in a paper entitled "The Origin and Structure of Plant Galls"[1] states: "Küster has classified galls on the basis of presence or absence of cell differentiation into two great groups: (1) kataplasmas or those in which the structure is undifferentiated parenchyma, and (2) prosoplasmas in which there is a differentiation into other tissues."

This interpretation of Küster's valuable classification is highly misleading and incomplete. In Küster's latest general work dealing with galls[2] on page 283 one may find the following: Kataplasma structures are those which fall below the corresponding normal part in their differentiation. They show no constant size, form or time of development. They may occur as the deformation of an entire organ or as a local growth." In all of his earlier

[1] SCIENCE, 57, 6-13, 1923.
[2] *Pathologische Pflanzenanatomie*, Jena, 1916.

writings Küster presents the same idea that kataplasmas may range from structures suffering slightly inhibited differentiation to those homogeneous parenchyma types in which differentiation is wholly inhibited. Nowhere does Küster restrict the term to the latter "undifferentiated parenchyma" type.

In the same paragraph dealing with Küster's terms Cook accepts the statement of the writer that galls of Nematoda, Lepidoptera and certain other animal groups are kataplasmas. The vast majority of these galls show differentiated cells, especially xylem and phloem elements and are never wholly composed of "undifferentiated parenchyma."

Regarding prosoplasmas Cook says "they are structures in which there is a differentiation into other tissues." No explanation of what these "other" tissues are like is appended, so the statement is meaningless. Küster has defined prosoplasmas as gall structures which are characterized by definite size, form and time of development and possessing tissue characters (form and orientation characters chiefly) which are new, *i. e.*, they are not duplicated in the host plant. They range from poorly differentiated types to ones highly differentiated.

In this connection attention should also be called to Cook's error in classifying crown gall as a "low type of prosoplasma" because they possess "rather weak fibrous tissue." Küster on page 152 of the above mentioned work definitely, and to the mind of the writer correctly, includes all bacterial galls under "kataplasmas."

From the above definitions of Küster's terms basic to the fundamental classification of galls it is apparent that the assertion of Cook that "Küster has classified galls on the basis of *presence or absence of cell differentiation* into two great groups" is entirely wrong.

B. W. WELLS

NORTH CAROLINA STATE COLLEGE,
RALEIGH, N. C.

ATHLETICS AND THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE propagandist for any particular reform is always ready and willing to enlist in his holy cause any agency capable of lending the slightest assistance, however remote the real aims of such agency may be and regardless of the possibility that the agency in question may have its hands more than full with its own proper business. This reflection represents the reaction of one reader to Dr. W. E. Allen's article in a recent number of SCIENCE. No doubt athletics is in a bad way in some seats of learning—although I hasten to disclaim any reference here to the Scripps Institution—and Dr. Allen's continual italicization of the word *commercialized* gives the whole matter an ugly look, while providing a convenient loophole for the escape of the administrator or professor who regards athletic activities at his particular college as *non*-commercialized, but before the association embarks upon the crusade, conjointly, of course, with all other societies interested in the advancement of knowledge, it would be well to make sure of the facts and relations involved.

Is it in reality true that earnest undergraduates, strongly or even feebly determined upon becoming, say, consulting chemists to the soap industry or uncompromising foes of the corn ear-worm, are turned aside from these worthy aims and their slender means confiscated by burly fullbacks and members of the "sporting fraternity," detailed for such canvassing? Is this sort of thing characteristic of many institutions of high standing? We know from recently published statistics that the higher grades of students go largely into university teaching with its implied devotion to research, and I, for one, scout the notion that such undergraduates are in any danger whatever of being led permanently astray by athletes or athletics, *commercialized* or pure. If I may be permitted to draw upon my own experience and observations at Harvard, I would affirm that such an opinion is pure nonsense, since each student is naturally regarded by his fellows as a free agent in such matters. Let those who are unduly impressed with this rare if not wholly imaginary seduction of infant scientists remember that there is something to be said on the other side; *organized* athletics provides in its public spectacles one of the rare spots of high color in a somewhat drab civilization, it furnishes funds which give the whole student body apparatus and opportunity for interesting and therefore wholesome

exercise, and it affords those capable of playing on the first teams a unique and invaluable chance to develop and display those extraordinary qualities of heart and mind required in their contests.

If an entirely unscholarly individual is hired to go to college so that the team may profit by his athletic prowess (as may still happen, I believe, in some sections of the country), if the coach pays the opposing captain to throw the game, if, worst of all, the student body in general is found prodigally to be wasting its money, time, interest and enthusiasm on sports to the exclusion of learning—then we have a black picture, indeed, but still indubitably a case for action by the administration of the institution concerned.

To enter this field, already under the anxious scrutiny and stern hand of those whose duty it is to guide such activities, would not only be a work of misguided supererogation, diverting the energy of the association from its proper aims, but it would, and quite properly, tend to alienate from science and scientists those students who, strange as it may seem to some honest souls, have at one and the same time a liking for sports, shared or watched, and for the study of nature. Let the association mind its own affairs, advancing the cause of science and ameliorating the conditions under which scientists labor, and recruits of promise will not be wanting.

H. M. PARSHLEY

SMITH COLLEGE

WAR EXPLOSIVES MISTAKEN FOR MINERALS

AT the close of the war, large quantities of explosives were distributed to the various states to be used mainly in bridge and road building. This material was frequently piled up in boxes in out of the way places where the containers sometimes became broken open and the explosives scattered some distance from the original source. The writer has personally observed one such case twenty-five miles south of Tucson, Arizona, where several tons of T. N. T. were kept for several weeks without guard or protection of any kind. Pieces of T. N. T. were picked up two or three hundred feet from the pile of boxes. As is well known, this substance turns yellow to brown on exposure to light and the stray pieces referred to above had so altered on the surface as to resemble rusty scrap iron. The pieces were of peculiar shape, some being cylindrical, evidently having been removed from unused shells. On breaking open some of the pieces with a hammer the material showed a fibrous radiating appearance not unlike some minerals. It does not seem strange, then, that occasionally these explosives should actually be mistaken for minerals. Moreover, in the case of more soluble substances such as picric acid, the material might become so mingled with sand or pieces of rock as to greatly increase the resemblance.

During the past year four distinct cases have been brought to the writer's attention where these explosives have presumably been mistaken for minerals. It has even led some men scientifically trained to seriously question whether these compounds might not actually occur as natural products. The first case was that of some earthy material stained with picric acid in such a manner as to almost exactly resemble carnotite. The material was received at the Arizona Bureau of Mines and the sender affirmed most emphatically that the substance was of natural origin. The bitter taste and the dyeing of a small piece of filter paper and comparing with a piece dyed with known picric acid was sufficient to identify the material.

The second case was that of a sample of whitish material, also received from a small town in Arizona by the Bureau of Mines. It was mingled with a very small amount of foreign matter and on testing was found to be T. N. T. (trinitrotoluene). In this case, on further correspondence with the sender, it was admitted that T. N. T. had been used the previous year near the locality concerned, and that some of the men interested in having the material tested had suggested that it might be an explosive. Had this information been included in the first letter a considerable amount of labor would have been saved in the identification.

The other two cases of widely different localities (New Mexico and Colorado) were called to my attention by Dr. S. C. Lind, of

the U. S. Bureau of Mines. In both of these cases the senders were, as stated by Dr. Lind, "not willing to accept the view" that the picric acid had been introduced accidentally.

The abundance of these explosives after the war, and the lavish way in which the government has distributed them for public service, together with the careless manner they have been handled in the road camps, is sufficient to explain the occasional finding of explosives under conditions which cause them to resemble minerals. It is not believed that these substances could be developed by natural agencies.

F. N. GUILD

UNIVERSITY OF ARIZONA,
TUCSON, ARIZONA

PARTIAL LIST OF BIOLOGICAL INSTITUTES AND BIOLOGISTS DOING EXPERIMENTAL WORK IN RUSSIA AT THE PRESENT TIME

THE list below was compiled by the undersigned during a trip to Moscow and Petrograd in August, 1922, taken for the purpose of investigating the biological sciences and scientists there and of reestablishing communication with them. Unfortunately, there was not sufficient time to make the list nearly complete. At all of these institutes research is being engaged in actively and articles are being published, but the work is much hampered on account of the lack of scientific literature from other countries, particularly from America. One of the greatest services that could be done to the Russian scientists at present is to help them to gain knowledge of the work which is being done in the west, and the list is therefore published to inform American scientific men of the addresses to which their reprints, and, wherever possible, the back numbers of their periodicals may be sent. Owing to the rather high centralization of Russian science, articles directed to these institutes will reach a large number of the people engaged in a given line of research. The articles may be mailed directly to addresses given, since postal communication has been reestablished, but they are to be addressed to the institute rather than to the person as such, in order to be sure that the Russians will not have to pay an import duty. Of course, the name of the person who would be most interested may be designated, even though the article is not sent to him personally.

H. J. MULLER
THE UNIVERSITY OF TEXAS

Bureau of Applied Botany, Professor N. I. Vavilov, director, and numerous others, Morskaya 44, Petrograd.

Scientific Institute of Ministry of Public Health, Professor Terasevitch, general director. This general organization comprises the following 8 institutes:

(1) Biochemical Institute, Professor A. Bach, director, and numerous associates, Vorontsovo Polye 8, Moscow.

(2) Institute of Control of Vaccines (including also station in country), Professor Terasevitch, director, and associates, Sivtsev Vrazhek 41, Moscow.

(3) Institute of Experimental Biology (including also 2 stations in country), Professor N. K. Koltzof, director, Sivtsev Vrazhek 41, Moscow; Professor S. N. Skadovsky, head of Hydrobiology Station; Professor V. N. Lebedof, head of Genetics Station; Dr. A. S. Serebrovsky (genetics); Dr. I. G. Kogan (sex hormones); Dr. D. D. Romashof (genetics and biometry); Dr. P. I. Shivago (histology); Drs. A. J. and S. S. Tchetverikov (entomology), and numerous others; address of all: Sivtsev Vrazhek 41, Moscow.

(4) Institute of Physiology of Nutrition, Professor Tchaternikof, director, and associates, Sivtsev Vrazhek 41, Moscow.

(5) Institute of Microbiology, Professor V. Barikin, director, Miss N. Kritch and other associates, Kudrinskaya-Ploshadj 8, Moscow.

(6) Institute of Sanitary Epidemiology, Professor Diatropof, director, and associates, Kudrinskaya-Ploshadj 8, Moscow.

(7) Institute of Tropical Medicine, Professor E. Martsinovsky, director, Kudrinskaya-Ploshadj 8, Moscow; Dr. Sh. Moshkovsky (chemotherapy, cultures, chemistry of histological staining, etc.); Professor I. Smorodintsev (enzymology); Dr. A. Adova (enzymology); Professor K. Skriabin (helminthology); Dr. P. Popov (helminthology and entomology); Dr. N. Shakov (malaria cultures, etc.); Dr. W. Povshina and Dr. A. Shtchurenkova (trichomonas, etc.); Dr. A. Metielkin (protozoan parasites); address of all: Kudrinskaya-Ploshadj 8, Moscow.

(8) Institute of Tuberculosis, Professor Varabiof, director, and associates, Kudrinskaya-Ploshadj 8, Moscow.

Institute of Biophysics (and physics), Professor P. P. Lazaref, director, and numerous associates, 3rd Miuska Ulitsa, Moscow.

Experiment Station for Investigation of Domestic Animals, Professor I. I. Ivanov (sperm studies), Khlebny Pereulok 9, 9, Moscow.

Central Institute of Work, Dr. K. Ch. Kektcheyev, director of physiological investigations, and associates, Moscow.

Agricultural Academy, Madame Nikolayeva (cytology), Petrovskaya-Razumovskaya, Moscow.

Zoological Institute, Professor Michael Savadovsky (sex studies); Professor Savadovsky (general biology), Zoological Garden, State University, Moscow.

Zoological Museum, Professor Koshevnikov (entomology), State University, Moscow.

Laboratory of Experimental Zoology and Genetics, Professor I. A. Philiptchenko (genetics), Dr. Vitaly M. Isayev (experimental zoology), First State University, Vassily Ostrov, Petrograd.

QUOTATIONS

FREE MUSEUMS AND GALLERIES[1]

A QUESTION addressed to Mr. Baldwin by Sir John Butcher yesterday revives the doubt whether it is wise to demand an entrance fee of visitors to the British Museum. The proposal, contained in the Increase of Fees Bill, which has passed its second reading, is that the public should pay for admittance the sum of sixpence on four days of the week; and it is calculated that an annual sum of £6,000 will thereby be raised for the finances of the museum. The government appear to entertain the belief, or perhaps only a pious hope, that the number of visitors will not be diminished in consequence; but the analogy of the National Gallery will not serve them. The entrance fee there, on students' days, is charged in order mainly to keep the general public out and leave the gallery more free to students; and there is no question that it has that effect. It may be assumed, therefore, that fewer people will go to the museum in future if the tax is imposed. We can not but hold the proposed tax to be a retrograde step. It is contrary to the traditions of the museum, contrary to the tendency of the age to regard museums and galleries as institutions of real educational value, and contrary to the whole educational policy of the country, which is to put knowledge more and more at the free disposal of all. It is a direct tax on knowledge.

Nobody can hope to understand much of what he sees at the British Museum, if he sees it only once, or attempts to race around all the rooms in an hour or two. Beauty, of which the museum is full, does not yield up its secret forthwith. But to any determined amateur, with the necessary curiosity and time at his disposal, the secret will reveal itself in the end, and he will be the better citizen for it. There is no reason why almost any Londoner should not, if the museums and galleries were always open for nothing, be able to constitute himself a connoisseur of beauty. The National Gallery, which has fewer free days than formerly, is without rival in the world; all that it needs is a public that understands what it has to confer—a catholic appreciation of painting, of all schools—after the requisite number, more for some and fewer for others, of visits. It is the same with the British Museum at Bloomsbury, a cathedral of the humanities, and at South Kensington of nature, also unrivalled. Only a narrow policy would seek to put a limit on the free entry of the general public into both places. Culture, if it is to exert its humanizing influence, must be spread in the widest commonalty. The exquisite shapes in the Tanagra Room, the stately avenue of books in the King's Library, the stones that still speak of man's struggle with the mastodon, are too good to be treated as if they were part of a circus or a cinema show. They and their companion collections in the national possession can not be looked at and visited too often. If funds be wanted for their upkeep, let vulgarity find them. It is ubiquitous, and could bear the tax without feeling it. But let the two principal national museums be open all days of the week free to all. At a great cost these collections have been founded and assembled; they were meant for the general enjoyment, and those who need their soothing and kindly influence most in their lives are often those who can least afford a fee to go to see them. When so many means of locomotion now converge on central London, it would be a monstrous paradox if what is most worth seeing there were made more difficult of approach.—*The London Times.*

[1] The British government has withdrawn its plan to charge an entrance fee to the British Museum.

CHEMICAL NOMENCLATURE[1]

1. IN naming a compound so as to indicate that oxygen is replaced by sulfur the prefix *thio* and not *sulfo* should be used (sulfo denotes the group SO_3H); thus, HCNS, *thio*cyanic acid; H_3AsS_4, *thio*arsenic acid; $Na_2S_2O_3$, sodium *thio*sulfate; $CS(NH_2)_2$, *thio*urea. The only use of *thio* as a name for sulfur replacing hydrogen is in cases in which the sulfur serves as a link in compounds not suitably named as mercapto derivatives; thus, $H_2NC_6H_4SC_6H_4NH_2$, thiobisaniline. *Hyposulfurous acid,* not hydrosulfurous acid, should be used to designate $H_2S_2O_4$.

2. The word *hydroxide* should be used for a compound with OH and *hydrate* for a compound with H_2O. Thus, barium hydroxide, $Ba(OH)_2$; chlorine hydrate, $Cl_2.10H_2O$.

3. Salts of chloroplatinic acid are *chloroplatinates* (not platinichlorides). Similarly salts of chloroauric acid are to be called *chloroaurates.*

4. Hydroxyl derivatives of hydrocarbons are to be given names ending in *—ol,* as glyc*erol,* resorcin*ol,* pinac*ol* (not pinacone), mannit*ol* (not mannite), pyrocatech*ol* (not pyrocatechin).

5. The names of the groups NH_2, NHR, NR_2, NH or NR should end in *—ido* only when they are substituents in an acid group, otherwise in *—ino;* thus, MeC(:NH)OEt, ethyl im*ido*acetate; $NH_2CH_2CH_2CO_2H$, β-am*ino*propionic acid (not am*ido*propionic acid); $NHPhCH_2CH_2CO_2H$, β-anil*ino*propionic acid; $CH_3C(:NH)CO_2H$, α-iminopropionic acid.

6. Hydroxy—, not oxy—, should be used in designating the hydroxyl group; as *hydroxy*acetic acid, $CH_2(OH)CO_2H$, not *oxy*acetic acid. *Keto—* is to be preferred to *oxy—* to designate oxygen in the group —CO—.

7. The term *ether* is to be used in the usual modern acceptation only and not as an equivalent of *ester.*

8. Salts of organic bases with hydrochloric acid should be called *hydrochlorides* (not hydrochlorates nor chlorhydrates). Similarly hydrobromide and hydroiodide should be used.

9. German names ending in *—it* should be translated *—ite* rather than *—it;* as permut*ite.* If it seems desirable to retain the original form of a trade name it should be placed in quotations, as "Permutit." Alcohols such as dulcitol (German Dulcit) are exceptions.

10. German names of acids should generally be translated by substituting *—ic acid* for "—säure." Some well-established names are exceptions, as Zuckersäure (saccharic acid), Milchsäure (lactic acid), Valeriansäure (valeric acid), etc. When the name ends in "—insäure" the translator *may* substitute *—ic acid* unless another acid already bears the resulting name; thus, Acridinsäure, acridic acid, but Mekoninsäure, meconinic acid, because meconic acid (Mekonsäure) is different. Names ending in "carbonsäure" are to be translated —carboxylic acid (not —carbonic acid).

MARCH 28, 1923

[1] Adopted by the Nomenclature Committee of the American Chemical Society and that of the London Chemical Society.

FISHERIES RESEARCH

THE British delegates to the International Council for the Exploration of the Sea, Mr. H. G. Maurice, assistant secretary of the Board of Agriculture and Fisheries, and Professor D'Arcy Thompson, scientific member of the Fishery Board for Scotland, have presented their report on the meeting of the International Council held in Copenhagen last September.

According to a report in the London *Times* their instructions were to press for the development of the work of the Council along practical lines, with a definite bearing on fisheries, to try to assign problems to the countries which could deal with them most effectively, and to ask for some definite pronouncement on the plaice question. They report success in each of these directions, and state that in view of the financial difficulties, the preceding year's work had been very encouraging.

The countries represented were Belgium, Denmark, Finland, France, Great Britain, Holland, Norway, Portugal and Sweden. Full details of the proceedings will be published by the Council; the delegates now direct special attention to the work of the Herring Committee, the Cod and Haddock Committee, the Committee of the Atlantic Slope, in which Great Britain has immediate interest, and to the plaice question, on which the council arrived at a unanimous decision.

The Norwegian Government is to be asked to take responsibility for, and bear the expenses of, the administration of the Herring Committee. The program of researches on herring is divided into eleven groups, which have been allotted to different nations. England is to take a special interest in the collection of statistics, investigation of younger stages of herrings and their distribution, location and characteristics of spawning grounds, and hydrographical and biological observations where fishing is going on and in the spawning grounds. Scotland, which has a deep interest and special opportunities, is to take a share in all the sections of the herring program.

There has been a similar distribution of the researches to be undertaken with regard to cod and haddock. England is to take her share in practically all the sixteen sections of the program, but is to hand over English haddock statistics to be dealt with by Scotland, and in return is to deal with the Scottish cod statistics.

The Atlantic Slope Committee is to investigate the hydrography and biology of the Atlantic Slope area from Gibraltar to Rockall. The work is to be shared by England, Scotland, Ireland, France and Portugal, and is to be carried out chiefly by regular cruises undertaken by research vessels.

Work on plaice has been going on for twenty years, Great Britain having taken a lead in it, with great help from Denmark and Holland, and from Germany before the war. There have also been valuable independent investigations made more recently by Germany. The recommendations adopted by the council were in effect those suggested by the committee.

The council agreed that there was clear evidence as to the possibility of serious depletion of plaice fisheries by fishery operations, and that such had actually taken place before the war. The forced restriction of fishing during the war had been followed by a large increase in average size and in numbers, but there is already evidence of a decline of the stock resulting from the resumption of intensive fishing. This decline is likely to be progressive; protective measures will become necessary in the near future. They recommend, therefore, the prohibition of fishing by steam trawlers and motor vessels of more than 50 h.p. throughout the year along a zone from the Continental coast to the 12-fathom line from about the Hook of Holland to the middle of Denmark, and, except during the months of April, May and June, to a 15-fathom line from Heligoland to the northern limit of the inner zone.

They suggest that measures of restriction should be reviewed three years after their inception, and point out that, although it is a matter for consideration by individual governments, the enforcement of restrictions will be difficult without the sympathetic cooperation of the trade. Finally, they urge a method of improving the fisheries suggested many years ago by Professor Garstang—the transplantation on a very large scale of small plaice from regions where they are overcrowded, to regions such as the Dogger Bank, difficult to reach by natural migration, and yet affording an abundant supply of food and suitable conditions for rapid growth.

The British delegates call special attention to the need of securing the cooperation of the British fishing industry, and advocate a preliminary discussion of the administrative aspects of the question by representatives of the departments concerned, the Admiralty and the Board of Trade, to be followed by conference with the industry. They also point out that when the government had come to a conclusion as to what measures they were prepared to advocate, there should be further conference with the other governments concerned, including Germany.

SPECIAL ARTICLES

CRITICAL POTENTIALS OF THALLIUM VAPOR

THE only published results of direct measurement of critical potentials for elements of the third column of the periodic table are the data on thallium vapor obtained by two of the authors[1] several years ago. The measurements given in Table III and Fig. 3, *l.c.*, showed inelastic collisions without ionization at intervals of 1.07 ± .1 volts and ionization at an *applied* potential of 6.6 volts. At that time the 1.07 volt impact was thought to be related to the infra-red line λ 11513 here designated as $2s—3p_2$. After correcting the 6.6 volt impact for initial velocity, the value 7.3 volts

[1] Foote and Mohler, *Phil. Mag.*, 37, p. 33, 1919.

TABLE I.

Volts	Excitation Transition	Radiation Transition	Wave-length emitted
0.962	$2p_2 \rightarrow 2p_1$	None	
3.269	$2p_2 \rightarrow 2s$	$2s \rightarrow 2p_2$	3776 A
		$2s \rightarrow 2p_1$	5350
4.47	$2p_2 \rightarrow 3d_{1,2}$	$3d_2 \rightarrow 2p_2$	2768
		$3d_1 \rightarrow 2p_1$	3519
		$3d_2 \rightarrow 2p_1$	3529
6.082	$2p_2 \rightarrow \infty$	Arc spectrum	

was obtained for the ionization potential, which corresponded to no known series limit. These data are inconsistent with the new Bohr theory of atomic structure, and for this reason it has been suggested[2] that a redetermination of the critical potentials of thallium was highly desirable.

Thallium shows a doublet spectrum quite similar to the alkalis except that the highest wave number in the spectra of the latter is 1s, while the highest known term for the metals of Group III is $2p_2$. Bohr's theory indicates that such a condition is to be expected and that $2p_2$ represents the normal state of the atom for these metals. Hence the ionization potential should be determined by this term. A recent paper by Grotrian[3] on the absorption spectra of thallium and indium has confirmed this view in a most conclusive manner.

We have redetermined the ionization potential of thallium by the Lenard method. The applied potentials were corrected (1) by measuring the velocity distribution of electrons and (2) by introducing mercury vapor and measuring the difference in the ionization potentials of the two elements. The two methods gave 6.02 and 6.1 volts respectively, with a weighted mean of $6.04 \pm .1$ volts. The limit $2p_2 = 49264$ corresponds to 6.08 volts in excellent agreement with the observed value.

Inspection of the previously published data shows immediately the source of error in the value of the ionization potential there given. The measured applied potential was corrected by comparison with the potential of the first inelastic collision. The first distinct point occurred at 1.55 volts, but in a single case[4] there was a slight indication of inelastic impact one volt lower. We concluded that this point was real, and that the distinct resonance at 1.55 was actually the second resonance collision. Our more precise recent experiments show that this faint inflection was due to an accidental variation in current, and it is unfortunate that we were misled in the interpretation of data, which, with this single exception, now appear to be fairly precise. Since actually the 1.55 volt collision, observed in our work of four years ago, is the first resonance point, the corrected ionization potential is readily seen to be 6.12 volts, a value entirely concordant with the more accurate work described above.

The resonance potential of 1.07 volts can not be ascribed to λ 11513, $2s$—$3p_1$, as this line is now known to be neither a resonance line nor an absorption line for the normal atom. The smallest quantum of kinetic energy absorbable by the normal thallium atom in its $2p_2$ state corresponds to $\nu = 2p_2 - 2p_1$, = 7793 $\simeq$ 0.96 volts. This is, within the error of measurement, in agreement with the observed value 1.07 volts. We have accordingly a peculiar type of resonance potential[5] since, unlike the metals of Groups I and II, the resonance collision is not followed by the emission of the corresponding single-line spectrum. The emission of $\nu = 2p_2 - 2p_1$ is forbidden by the principle of selection for azimuthal quantum numbers. Hence collisions of this

TABLE 2

CRITICAL POTENTIALS FOR ALUMINIUM SUBGROUP (IN VOLTS)

Element	Ionization		Resonance Potentials		
	$2p_2$	$2p_1$	$2p_2$—$2s$	$2p_2$—$3d$	$2p_2$—$2p_1$
Al	5.960	5.946	3.129	4.004	0.014
Ga	5.973	5.871	3.060	4.294	0.102
In	5.761	5.488	3.009	4.06	0.273
Tl	6.082	5.120	3.269	4.47	0.962

[2] "Origin of Spectra," Foote and Mohler, page 65.

[3] Grotrian, *Zeit. f. Physik.*, 12, p. 218, 1922.

[4] l. c., Fig. 3, curve 9.

[5] A somewhat similar phenomenon is exhibited by the lower resonance potential of helium.

type produce a metastable form of thallium.

In addition to this type of collision there should be at least two other resonance potentials and each of these will give rise to several lines in emission. Table I shows the probable stages in the excitation of normal thallium.

Metastable thallium, which Grotrian shows may be produced by heating to 800°C., should have resonance potentials about one volt lower, corresponding to $\nu = 2p_1 - 2s$ and $\nu = 2p_1 - 3d_{1,2}$.

One may now predict with certainty the critical potentials for other elements in this group as shown in Table II. Further work with these vapors is in progress.

F. L. MOHLER,
PAUL D. FOOTE,
A. E. RUARK

BUREAU OF STANDARDS,
WASHINGTON, D. C.

CROSS-INOCULATION STUDIES WITH CUCURBIT MOSAIC

CONTINUED cross-inoculation studies with cucurbit mosaic have shown that the disease may be transmitted to nearly all species of the cucurbits and to a number of plants in families other than the cucurbitaceæ. The cross-inoculation experiments with the cucurbits, described in an earlier paper,[1] have been continued until we now have 8 genera, 23 species, 8 varieties and 96 horticultural varieties which are known to be susceptible to the disease. This list includes a number of species and varieties from Europe, Asia and Africa. With the exception of the genus *Citrullus*, all of the cucurbits thus far inoculated have proven susceptible to mosaic. Inoculations in this genus have included twenty varieties of watermelon and citron, but infection has been secured only in the case of the green-seeded citron,[1] which appears to be susceptible to the disease.

Cross-inoculations with plants of other families, as earlier reported, gave some evidence that cucurbit mosaic was transmissible to martynia (*Martynia louisiana*),[1] pepper (*Capsicum annuum*),[2] milkweed (*Asclepias syriaca*),[2] and pokeweed (*Phytolacca decandra*).[3] Further studies have shown that cucurbit mosaic is readily transmissible to these hosts and back to the cucumber. The disease has also been transmitted from milkweed to both martynia and pepper and back to the milkweed. The writers have found that the most uniformly successful method of inoculation consists in the transfer of aphids from a mosaic plant to the plant inoculated, but successful results have also been obtained by artificial inoculation with the crushed tissue or expressed juice of mosaic plants.

We have also found that cucumber mosaic is readily transmissible to tobacco through the pepper and *vice versa*, the pepper apparently acting as an intermediate host. Numerous direct inoculations from cucumber to tobacco have been unsuccessful up to the present. Elmer,[4] however, reports that he has secured infection on cucurbits inoculated with tobacco mosaic and *vice versa*.

A continuation of the earlier experiments with the potato[3] has shown that cucumber mosaic is apparently transmissible to this host. We have secured a high percentage of infection in several series of inoculations to the cucumber from potato plants which had earlier been inoculated with cucumber mosaic. Tubers from potato plants which were inoculated from the cucumber in 1921 developed symptoms of mosaic when grown in the greenhouse during the past winter. Experiments also indicate that potato mosaic may possibly be transmitted to the pokeweed. In the latter experiments the potatoes used were from mosaic stock secured in northern Wisconsin. These experiments are still in a preliminary stage, however, and are being continued at the present time. During the past summer it has been found that cucumber mosaic may also be transmitted to the pigweed (*Amaranthus retroflexus*) and to a cultivated ground cherry (*Physalis sp.*).

A complete report of this work is being submitted for early publication.

S. P. DOOLITTLE
M. N. WALKER

U. S. DEPARTMENT OF AGRICULTURE
AND WISCONSIN AGRICULTURAL
EXPERIMENT STATION.

[1] *U. S. D. A. Bull.* 879, 1-69, 1920.
[2] *Phytopathology*, 11, 47, 1921.
[3] *Phytopathology*, 12, 42-43, 1922.
[4] SCIENCE, 56, 370-373, 1922.

A FURTHER NOTE ON THE FRESH-WATER MEDUSA

IN SCIENCE of December 8, 1922, Professor H. Garman reports some later observations on the medusæ of Benton Creek, Kentucky, where they were found in large numbers in the late summer of 1917 as they had been the previous summer. In the present note he reports that careful search for the hydroid stage at several times had been without success, but mentions finding in September, 1922, colonies of *Cordylophora lacustris,* a well-known hydroid of fresh and brackish waters, and remarks upon its occurrence in " a new locality in which it is associated in a way with Craspedacusta," though adding in a foot note that "a medusa stage is believed not to be produced by this hydroid."

It seems to the writer that it may be well to briefly summarize present knowledge of this very interesting problem in order that subsequent findings may be properly correlated with what has already been established.

Cordylophora lacustris: This hydroid was first described by Allman in 1844 (*Annals of Nat. Hist.*, vol. xiii, p. 330, and later in his "Monograph of Gymnoblastic Hydroids," 1871, p. 252). Hincks described its life history (*Ann. Nat. Hist.*, 1853, and still later in his History of Brit. Hydroid Zooph., 1868). Details of its habitat have been given from time to time by scores of zoologists, but the fullest account of its development is that of F. E. Schulze in 1871 in a memoir of some 52 pages with six lithograph plates. Its life history is therefore as clearly established as that of any known hydroid. Of course, one of its very interesting peculiarities is its adaptability to both salt and fresh waters, and it has quite a wide and varied distribution, records of its occurrence in inland waters having been made by many observers. Hence there is no special significance in its occurrence in the Kentucky creek and in the same locality as that of Craspedacusta several years prior.

Microhydra Ryderi Potts: This very remarkable hydroid was discovered by Mr. Edward Potts in 1885, and was described by Dr. J. A. Ryder (*Amer. Naturalist,* vol. 19, p. 1232) at the request of Mr. Potts, who supplied the material and data as to its localities. The untimely death of Dr. Ryder soon after this delayed further accounts for several years. In 1897 Potts was fortunate in having actually observed the development and liberation of its medusa stage, and this he repeatedly confirmed by studies in subsequent years.

A later and final account of this hydroid by Potts appeared in *The Quar. Jour. Micro. Science,* vol. 50, 1906, including notes by Lankester, and drawings from several authors, making a comparatively complete account of the entire life history of the hydroid. As will be found in the description given, the size of the hydroid stage is extremely minute as suggested by the generic name given to it. Its size as given is only about 0.5 mm. in height, by less than one half that in diameter. Search for it would therefore be like that for the proverbial needle in a haystack.

It is doubtless due to this feature of minuteness that this hydroid has been so rarely seen. Added to this feature is also that of its anomalous characters of structure, for example, absence of tentacles, hydrorhiza, etc., which add to its disguise. Unless one were familiar with these facts, or had seen descriptions and drawings, it would be quite easy to overlook organisms such as these even when knowing something of the objects of search. One other feature also further obscures the hydroid, its very quiescent or sluggish habit, often being motionless for some time, and its motion unlike that of Hydra or other hydroid forms as commonly known. Further accounts along this line will appear under the following section.

Craspedacusta sowerbii Lankester (*Limnocodium sowerbii* Allman). Under these names are designated the fresh water medusa first made known by Lankester, and at the same time by Allman, in 1880; but that given by Lankester having been first published takes precedence. Its discovery was first made by Mr. Sowerby, secretary of the botanical garden of Regents Park, London, who supplied specimens to Professor Lankester. The fact that the specimens were found in large numbers in the tank where the giant water-lily, Victoria regia, was grown, having been brought from South America, led to the inference that the medusæ had been brought also from the same region of the tropics. As is now well known,

this inference is probably erroneous, since the wide distribution in other localities, most particularly in the United States, where they have been found in natural waters, lakes and creeks, accounts of which the present writer has given, first in SCIENCE, November 8, 1907, and later in the *Biological Bulletin*, vol. xiv, 1908, p. 304. Its next occurrence is that reported by Professor Garman in SCIENCE, December 15, 1916, and finally that described by the present writer in SCIENCE of October 31, 1919, and the note by Garman referred to in the opening paragraph of this paper. The following letter from Dr. R. E. Coker, of the Bureau of Fisheries, Washington, D. C., establishes still an additional locality for Craspedacusta in the United States:

> Your somewhat recent paper in SCIENCE concerning fresh-water medusæ recalled to my mind the fact that I had not acquainted you with the examples which I collected on September 16, 1918 in Augusta, Georgia.
>
> During a very brief stay in Augusta, my attention was called to the medusæ by Mr. Schultze, of the Public Health Service at that time, formerly with the Berkman nurseries of Augusta, Georgia, who during the previous few days had observed them abundantly in a concrete pool in the corner of the yard of the Catholic church. He was, of course, interested in knowing what they were, and properly suspected them to be jelly-fish.
>
> The pool was about 14 feet in diameter and 2½ feet deep; the intake was in the center, arising, I am told, from the city water system. The normal over-flow pipe was stopped up and the water was running over slowly on one side. There were no large plants, but the side walls were covered by a coating of sediment about half an inch thick and greenish in color. The medusæ were very active in a bottle of water, making as many as 114 strong pulsations to the minute. Five specimens were kept in a small bottle with some of the sediment from September 16 to 23, inclusive, when they died in my office in Washington. About a dozen examples were preserved in alcohol, the only thing available for the purpose at that time, and subesquently deposited in the United States National Museum under its accession number 62,830. They were presumably *Craspedacusta sowerbii*.

For a long time the medusa stage was the only aspect of the organism known. But in 1884 Bourne described a hydroid stage (*Proc. Royal Soc.*, London) and still later an extended account by Fowler was given (*Quar. Jour. Mic. Sci.*, vol. 30, 1890, p. 507, plate 32, nine figures) which includes an account of the liberation of the medusa and some details of its structure. Fowler's polyps were larger than those of Microhydra described above, but otherwise very similar. These accounts, with those of Lankester (*Quar. Jour. Mic. Sci.*, vol. xx, p. 351) will afford an excellent résumé of the life history up to that time. But it yet remains for further investigations to complete full and unquestioned life history of these most interesting organisms.

Another very interesting feature associated with the appearance and distribution of these medusæ is the anomalous and erratic aspects of their occurrence and, to a less degree, their more or less sudden disappearance. This point was very marked of their presence in the tanks of the Regents Park as reported by Bourne, Fowler and others. This was equally marked in the history of the medusæ in the Washington aquaria as I have shown. It was likewise noted in those of Benton creek, Kentucky, at the close of the first summer, *i. e.*, 1916, to which the present writer referred, and which Professor Garman, in his recent note in SCIENCE, December 8, 1922, deems an error. But this referred only to the particular feature here cited and was based on a letter from Professor Garman of December 21, 1916, in which he states: "You may be interested in knowing that on September 30, after I secured the medusæ, another trip was made to the creek with a view to learning something further of the organisms. I examined the banks from above backwater down to the mouth of the creek, but found neither medusæ nor colonial forms. A rain had followed my first visit, so that the stream was much above its former level and was muddy. This condition may account for the failure in the second trip to secure specimens." This last report of Garman establishes the recurrence of the medusæ in Benton Creek in 1917, though not since then. Advices indicate that at the Elkhart locality these medusæ have thrived without interruption since their first discovery some five years ago.

In his earlier account of the medusæ, the